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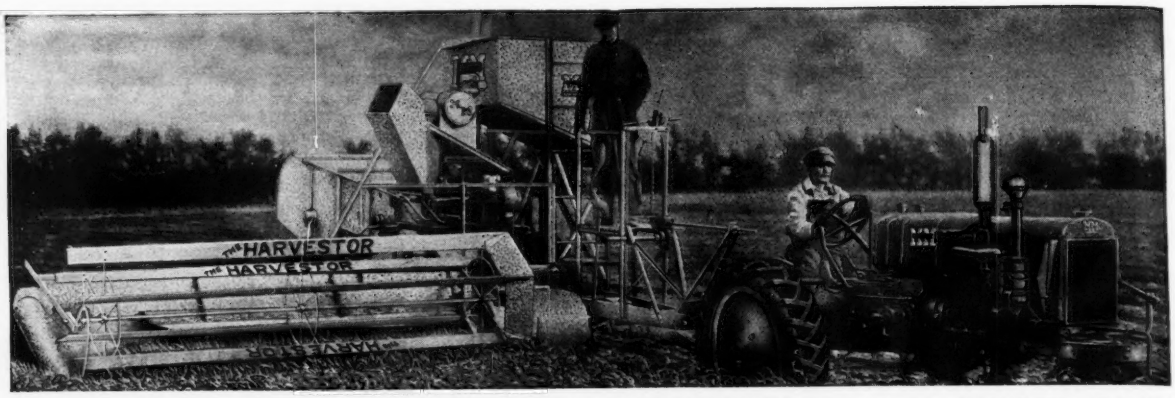

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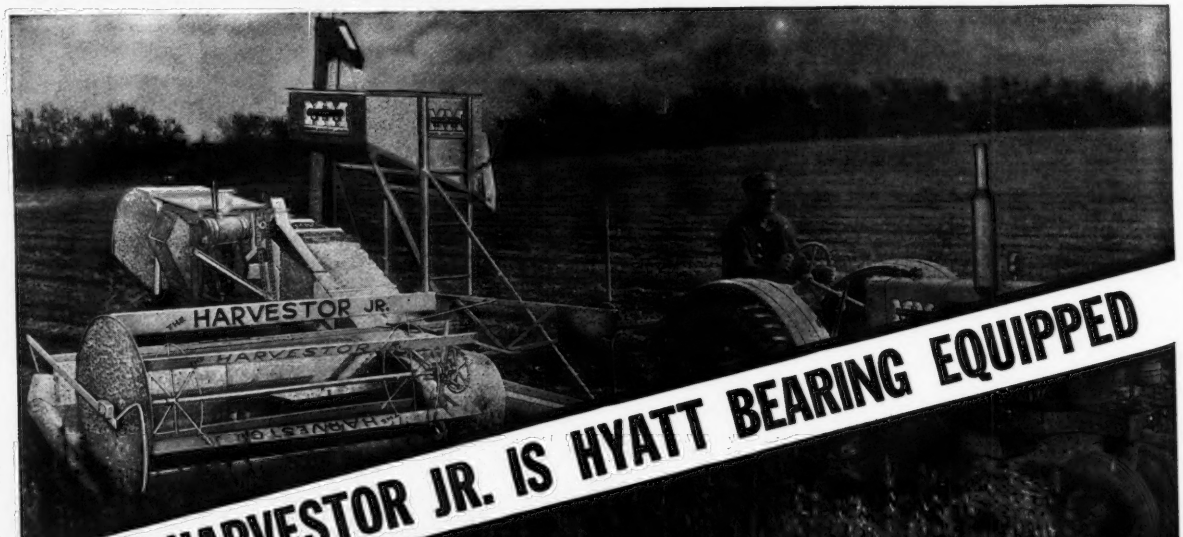

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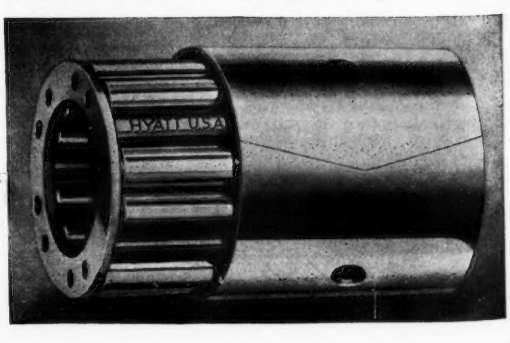

AGRICULTURAL ENGINEERING

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AEC Effectiveness

LIKE THE slide rule, American Engineering Council is an engineer's instrument for getting things done.

In its field of public affairs it is the efficient, short-cut method of measuring the resultant of cumulative engineering experience and viewpoints.

Every member of every member organization should consider it a part of the professional equipment which enables him to serve as an engineer.

It is a rugged instrument built for field service; it need not be kept in a plush and leather case. Neither is it fully automatic. It must be used to show results.

One way for the individual engineer to contribute to Council's good works, even though he is not a representative or committee member, is to express to Council his experiences, views, and suggestions in the fields of its activities of interest to him, or in any field of his interests which he believes should be included in its activities.

Every engineer worthy of the name has unselfish thoughts on matters of national significance. They may seem trivial, but they are worth recording. They may not gain immediate support, but the originator may live to say "I told you so," if he is thus inclined. Expressed ideas are the small, hot sparks which continually relight the fires of progress.

Council can truly represent only those who express their views to it. Failure to give it information and viewpoints weakens the engineering background upon which its activities are based.

If it gives out information or supports principles and activities in line with the unexpressed views of any individual member, that is an accident. He has added no weight thereto. If its activities are contrary to his unexpressed views, the responsibility is his for failing to give opportunity for consideration of his views.

If Council's activities are in accord with a member's expressed views, his expression gives them strength in the added known weight of his approval. If its activities are contrary to his expressed views, he may be sure that his minority viewpoint has been considered, has influenced the final decision, and stands on record to influence future decisions. Whatever truth such minority viewpoints contain will gather strength from experience.

Another way in which the individual engineer can increase the usefulness of Council is to refer to its public servants and others in search of public engineering information.

As a representative organization, Council acts in the directions indicated by those whose public and professional spirit make their representation felt. Its committee work is done largely by those who have indicated the need of specific activities. If any desired work remains undone, it is probably because the cause remains unsponsored by those who see the need.

In an editorial, entitled "AEC on the Straight and Narrow," appearing in AGRICULTURAL ENGINEERING for September 1936, we elaborated on the merit of concept and organization inherent in the AEC. An added element of strength is its sixteen years of organizational experience, prestige, good will, and membership growth. The staff in Washington has proved itself efficient in getting and distributing information, and in otherwise carrying out the policies established by its members through the assembly and the executive committee.

But there is no magic in organization. The work must still be done, the facts assembled, and the influence exerted by individual human beings—people. No group can hire a staff to unburden it of its social responsibilities or those of its individual members. The staff's purpose is to help discharge those responsibilities. Representation must remain effective.

AEC must be more than an abstract entity to the individual engineer. If he is a member of a member society, he is as much a part of it as anyone else, and it is as much his instrument to get done the things in its field for which he sees a need. It is no clique of engineers in high position. It is more than a headquarters in Washington. It is a sounding board on which every individual member can and should effectively impress his experience, views, and suggestions on public engineering matters. It can be as effective in its field, in the mutual interest of engineers and the public, as it is made by the individual members of its member societies.

A Classification of Agricultural Engineering Application

IN reviewing the work of agricultural engineers for indications of further opportunity in this field, we have taken the contents of AGRICULTURAL ENGINEERING from 1920 through 1936 as a fair representation of the range of their interest and activity.

The articles were found to divide into four general groups according to application. Many apply to agricultural production in general or to specific animal industries, crops, or classes of crops. The largest number of contributions represent application of engineering thought and work to specific farm operations and operating equipment. Professional history, outlook, problems, methods, etc., form another group. Incidental interest in and work on engineering matters not limited to agricultural applications forms the fourth classification.

Operation and operating equipment work can be done effectively by the time-proven method of analyzing whole large problems into their component individual, man-sized problems capable of understanding and solution within practical working limits of time and funds. The cumulative effect of this piecemeal application has been a widespread, general and consistent progress in farm operating efficiency and living comfort.

Specific animal industry and crop problems are likewise susceptible to piecemeal solution. Application of engineering to the production of a crop from seed to harvest and storage, to an animal industry from feeding to market, to an individual farm as an income producer, or to such community and national problems as land-use planning, requires the additional and supplementary engineer-

ing technique of organization and integration. The interrelated factors of farm production economics, the efficient economic balancing and application of equipment to increase the overall efficiency of farm production; the integration of bits of engineering information and its organization for cooperation with the biologic and other sciences for mass attack on large problems—these are definite fields of agricultural engineering opportunity.

It is natural and logical that agricultural engineers in the course of their work should incidentally develop information, techniques, devices, and materials which find use in other application fields. It helps balance the account with other engineering fields for the things agricultural engineers have borrowed and put to agricultural uses. A large part of the effectiveness of engineering is due to the freedom with which all engineering information and developments are made available, exchanged, and applied to problems in fields other than those in which developed.

Individual and group consideration of the past, present, and future of agricultural engineering is the steering gear of agricultural engineers, professionally and technically; individually and collectively. That its volume has been substantial is an auspicious omen.

To young agricultural engineers seeking opportunity within their jobs; to experienced agricultural engineers seeking to direct effectively their work and that of others; to all who may be engaged in obtaining or revising their bird's-eye view of this branch of the engineering profession, we submit for consideration these unconventional views on the applications of agricultural engineering thought and work.

Key to Chemurgy

DR. C. M. A. STINE has pointed to lower farm production costs as the key to farm chemurgic progress, in the following words: "The real difficulty in agriculture is the farmer's inability to grow and sell crops at prices low enough to make their conversion economically practicable. Between raw materials of similar properties the chemist has no choice other than the lowest price. Why make alcohol from corn when that from molasses is as good and cheaper? Why make paper from cornstalks when wood pulp costs much less and is more readily available? Why use wheat when sawdust will do as well? The big problem of wholesale use of crops by industry is one of economics, not chemistry."

Therein lies chemurgy's challenge to agricultural engineers, already in the farm field with engineering technique, one of the highly effective agencies for lowering production costs wherever it is applied.

"Comparative Efficiencies of Hay Storing Methods"

To the Editor:

THE PAPER by Cannon, Collins and Espe, entitled "Comparative Efficiencies of Hay Storing Methods," appearing in AGRICULTURAL ENGINEERING for April, contains a lot of data well worth the attention of every agricultural engineer. As one who has spent a good share of his time for the past nine years working on hay storage methods, I would like to offer my comment on this very able paper.

At the outset of the paper, it is stated that manufacturers of hay choppers and grinders have claimed that processing increased the nutritive value of hay. While some manufacturers have undoubtedly made this unqualified claim, it is only fair to point out that more responsible manufacturers have from the beginning very consistently and correctly based their claims on the fact that chopping increases the value of the average hay crop, not because digestibility is improved, but because feeding waste is reduced. Feeding trials at a score or more of stations have shown that cattle and sheep waste from 10 to 40 per cent (depending on quality) of all hay received when it is fed unchopped, as compared with less than 5 per cent waste when the same quality hay is fed in chopped form. If chopping $15.00 hay eliminates a 10 per cent feeding waste, chopping will be profitable as long as it increases hay handling and storage cost less than $1.50 per ton. Actually, chopped hay can be put into storage at a cost of only a few cents per ton more than whole hay at the maximum, and at considerably less cost on many farms.

In the second paragraph of the paper, the authors point out that they were unable to find previous data comparing costs of storing chopped and whole hay direct from the field. In 1932 the late Fred J. Bullock, assisted by the writer, made a study of this sort on one hundred farms located in twenty-two different states. Results were published in AGRICULTURAL ENGINEERING for June 1933, under the title "Cost of Storing Chopped and Whole Hay."

The final comparison of the Iowa State College farm data with our averages for one hundred farms in twenty-two states may be of interest:

	Whole hay		Chopped hay	
	Iowa	22 states	Iowa	22 states
Total tons stored	161	9,900	150	10,600
Tons stored per hour	4.53	2.89	4.50	3.96
Size of crew	3.50	3.89	2.00	2.08
Man-hours per ton stored	0.77	1.35	0.41	0.53
Charge per ton for use of storing equipment	None	$ .122	$ .072	$ .231
Charge per ton for labor	$ .277	.337	.145	.131
Charge per ton for horse labor	.044	.069	None	None
Charge per ton for use of tractor	None	None	.154	.152
Total cost per ton stored	$ .271	$ .528	$ .371	$ .514

It will be immediately apparent that both whole and chopped hay handling methods were much more efficient on the Iowa State College farm than on the average farm. Any conclusions drawn from the above comparison must, however, be tempered by the following facts: The Iowa costs include no charge for use of whole hay handling equipment. The Iowa labor costs were figured at 35 cents per man-hour as compared with 25 cents per man-hour for the average farm. A $700 chopper was used on the Iowa State College farm as compared with a $400 chopper on the average farm, which makes a charge of only 7 cents per ton for the use of the chopper on the college farm seem very low in comparison with a charge of 23 cents per ton for the use of a less expensive chopper on the average farm.

F. H. HAMLIN

Papec Machine Company
Shortesville, New York

Wind Erosion and Its Control

By Raymond R. Drake

WHEN the Great Plains were discovered by the white man, wind erosion was occurring along Indian trails, at watering places for buffalo, and wherever the native vegetation was destroyed. Early hunters, traders, and cattlemen destroyed little vegetation. When the pioneers broke the virgin sod and placed the land in cultivation, wind erosion became more of a problem. The erosion problem was further aggravated as a result of increasing the amount of land in cultivation.

Traders and cattlemen occupied this area for a long time before it was farmed. Until 1900, little land was in cultivation. Between 1900 and 1920, however, large areas were put in cultivation. The most rapid expansion occurred after the World War when practically all suitable, and many unsuitable, areas of native sod were put in cultivation. Many of those areas within a few years were seriously damaged by wind.

When the land is placed in cultivation, the soils are left to the mercy of continuous winds, except when protected by growing crops or proper tillage. When there is a long period of drought and crop failures, little vegetation remains. Tillage and weathering of the soil tend to pulverize it to a fine dust, thus making ideal conditions for serious wind erosion. Over-grazing pastures has a similar effect, since it removes vegetation; and trampling tends to pulverize the ground surface, thus making it easy to blow.

One of the first extensive areas to be seriously affected by wind was near Colby, in Thomas County, Kansas. Before that area was brought under control in 1914, more than 65,000 acres had been damaged seriously.

Agricultural prosperity caused the rapid expansion of crop lands and the two-year local drought, 1910-1911, brought about conditions favorable for blowing. The total precipitation for the year 1910 was only 6.62 in, an all-time low record, followed by only 10.55 in in 1911. During those two years, all crops failed. The absence of vegetation, lack of soil moisture, and the cultivation of soil so affected the ground surface that the 20.02 in of rain in 1912 and the 21.49 in in 1913 did not provide enough moisture, nor were rains timely enough to stop the shifting silt and sand sufficiently long to give vegetation a chance to become established. The blowing reached its maximum intensity in the spring before the May rains in 1914. In 1914 community action was taken to prevent the enlargement of the blowing area. The fields were listed solid or in strips at right angles to the prevailing winds. J. B. Kuska, associate agronomist of the division of dry land agriculture at the Kansas Agricultural Experiment Station at Colby, who assisted with the control program, reported as follows upon the methods used and the success of the undertaking:

> A program was undertaken of listing solid, or every other row, or in strips as close as possible with the listers available and planting the land to corn or other row crops. The listing was done in an east to west direction. Much of the area was so handled. For a time it looked as though even these efforts might be unsuccessful. Whether or not the efforts would have been successful of themselves will always remain a question. At about this time nature came to the rescue. A rainy period set in after the first week in May, during which it rained nine out of eleven days. These showers brought up whatever had been planted, sprouted the weed seeds which were abundant everywhere, and kept the soil from blowing long enough to give the crops and weeds a chance to become established. . . . . There was an abundance of moisture in the soil, and, given a start, all vegetation made rank growth. Practically all this was left over winter as protection against possible blowing the following year.
>
> Nature, having started the healing process, appeared to be reluctant to turn the job over to man at this stage. The first nine months of 1915 the precipitation was above normal every month and the total for the year was 28.99 in, only 0.5 in below the all time record. . . . . That fall there was an abundance of moisture for fall wheat to start and make a good growth before winter set in. The following spring there were only a few bare fields, mostly fields where the wheat was sown too late to make enough growth to cover the ground. Most fields were covered with growing wheat, heavy stubble, corn or sorghum stalks, or weeds. High winds were frequent during the spring months, and many of the fields of late wheat blew out, but no extensive areas could blow because of the vegetation. The blowing fields were strip listed or otherwise worked to check the blowing in most cases, so that the blow district was farm land again.
>
> Since then almost every spring with the exception of 1919, there has been some trouble experienced with wheat blowing out in this vicinity. At no time since, even in the years when wheat winterkilled, or during the driest years has there been any extensive area of uncontrolled soil blowing. Thousands of acres of winter wheat have been destroyed, but by the timely use of the lister and other precautionary measures, the land was saved from devastation.

The conditions causing the dust storms of 1933-35 in

Presented before the Soil and Water Conservation Division of the American Society of Agricultural Engineers at Chicago, December 3, 1936.

Author: Associate agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. Assoc. Mem. ASAE.

WIND EROSION PREVENTION METHODS

(Left) One-way disk plows and subsoil packers preparing the final seedbed for wheat. The stubble is thoroughly mixed in the soil and the soil firmly packed. (Right) A row-crop field after harvest effectively protected from wind erosion by strip listing parallel to the sorghum rows, which were planted at right angles to the prevailing winds

the Central Plains states were similar to those in the Colby area in 1910-14. An expansion of agricultural prosperity prior to 1931 was followed by a five-year drought, each consecutive year of which showed an increasingly deficient annual precipitation. Practically all crops failed. A minimum annual precipitation occurred in 1934. Annual precipitation as recorded by the U. S. Weather Bureau at Colby, Tribune, and Garden City, Kansas; Springfield, Colorado, Dalhart, Texas, and Tucumcari, New Mexico, is typical of this area.

	Kansas			Colorado	Texas	New Mexico
Year	Colby	Tribune	Garden City	Springfield	Dalhart	Tucumcari
1931	16.08	10.17	17.73	13.51	14.66	18.09
1932	15.09	18.76	16.25	17.85	20.09	16.51
1933	18.14	17.45	18.84	12.24	10.14	16.46
1934	8.60	7.76	9.08	11.45	9.78	6.13
1935	13.23	8.83	9.56	10.42	13.31	12.88
5-yr average	14.23	12.59	14.29	13.09	13.59	14.05
All-time average	18.49	16.63	19.52	17.33	19.08	17.25
Years record	44	36	46	48	28	31

Wind erosion throughout the Central Plains states of Colorado, Kansas, Nebraska, Oklahoma, New Mexico, and Texas during this period was more extended and more destructive than in any other similar period since the native soil was broken for crop production. Millions of acres were damaged, and from tens of thousands of acres of level to slightly rolling land, the soil was blown as deep as the field had been tilled the previous year. Fences, Russian thistles, weeds, shrubs, farm machinery in the fields, farmsteads, windbreaks, roads, and any other obstruction that might retard the wind velocity and permit the soil to settle were filled with wind-blown silt and sands. The highest intensity of the black blizzards, which caused loss of life and destruction to property, occurred in the spring of 1935.

The practice of burning wheat stubble on many fields in 1931 and the tillage necessary to prepare the lands for crops during the drought period, made the soil loose and dusty. Also vegetation and decaying organic matter were not present to hold the weathered, dusty soil in place. Abnormally low rainfall throughout the area in 1934 made it impossible to secure satisfactory stands of winter wheat, and where stands were secured the deficient winter precipitation was not sufficient to keep them alive. The scarcity of livestock feeds from cultivated areas necessitated heavy grazing of pastures, roadsides, and vacant fields, thereby removing practically all vegetation from the pastures and cropped fields. Sorghum stalks, small grain stubble, Russian thistles, and other weeds were put up for winter feed. The annual windy season in the winter and spring of 1935 found the region practically denuded of all vegetation and with a soil surface exceedingly susceptible to blowing. The farmers' resources were so exhausted by previous unavoidable crop failures that they were unable to use even temporary methods of erosion control.

The federal relief administration appropriated funds to the states affected. County poor commissioners distributed the funds to needy farmers to buy gas, oil, or feed so that they could list or work their eroding fields in an approved manner to control blowing. Listing the fields solid or in strips on the contour was practiced in many counties to control erosion by the constantly changing winds, and to retard runoff losses from heavy rains.

Wind erosion will occur in the future whenever there is a long period of drought, if vegetation is removed by burning, overgrazing, and continuous improper tillage. By proper and timely tillage, proper land use, and controlled grazing, erosion by wind can be controlled over long periods of time.

Soil blowing on land continuously cropped to wheat can best be controlled by cultivating immediately after harvest, with a lister, one-way disk plow, or duckfoot cultivator. The duckfoot can be used, provided the stubble is not too heavy or the soil too dry and hard. These implements cover some of the stubble but leave some uncovered and some only partially covered. Land treated in this way will not blow badly and is in good condition to retain sudden heavy rains. The next operation should be made preferably after a few rains have occurred and weed growth started. The field may be relisted by splitting the ridges, or the ridges may be worked down with a ridge buster, weeder, or other implement capable of leveling the ridges and furrows. This second operation further mixes the soil and partially decayed stubble. The amount of rainfall usually determines the number of times the soil must be worked to destroy weed growth. Whatever implement is used, the surface soil should not be worked to a fine dust mulch. A cloddy surface absorbs rainfall and controls blowing. Such implements as the duckfoot cultivator, springtooth harrow, subsoil packer, and rod weeder are much preferred to the one-way disk plow, tandem disk harrow, pegtooth harrow, clod crusher, or surface roller for prevention of soil blowing. For seedbed preparation, the proper use of the lister, ridgebuster, one-way disk plow, duckfoot, and subsoil packer will usually be found sufficient for small grain and sorghum crops.

The methods of tillage and the implements described above for continuous wheat may be used in the fallow system. Fallow tillage begins early in the spring, before weed growth starts. The land must be kept in a roughened condition and free of weeds. A roughened, cloddy surface is difficult to maintain because of the lack of undecayed stubble and the necessity of tillage operations which tend to pulverize the soil to a fine dust. Basin-listing, and re-basin-listing by splitting the ridges, is one of the best methods of reducing the water and soil loss, improving soil tilth, and thoroughly mixing the old decaying stubble in the soil. In the winter wheat area of the Plains the field should be allowed to remain in a rough condition until 30 to 60 days before seeding. Then the lister ridges must be worked down, subsoil packed, and field rendered free of weeds, but care must be taken not to produce too fine a surface soil by the use of disks or drags.

When sorghum row crops are grown, the rows should run at right angles to the prevailing winds, to prevent the hot summer winds from blowing down between the rows of growing plants, and to control wind erosion more effectively after the crop has been removed from the fields. If the crop is harvested by cutting the plants within a few inches of the ground, blank listing in the fall should be practiced. Harvesting the crop with a combine leaves a protecting stubble of from 12 to 24 in.

Overgrazing and trampling of pastures are detrimental to native grasses. In an overgrazed pasture undesirable grasses and weeds will eventually replace desirable plants. Rotation and deferred grazing are giving excellent results in maintaining desirable grass stands and controlling water and wind erosion. Contour pasture furrows are receiving much attention throughout the *(Continued on page 200)*

How Agricultural Engineers Can Best Cooperate with the REA Program

By Oscar Meier

IN CONSIDERING how agricultural engineers can best cooperate with the Rural Electrification Administration program, we must have clearly in mind just what the REA program is.

After the REA operated for a year as an emergency agency created by executive order of the President, Congress last spring passed the Norris-Rayburn Bill, which is officially labeled the "Rural Electrification Act of 1936."

Section 2 of this Act defines its purposes in the following words: "The Administrator is authorized and empowered to make *loans* in the several states and territories of the United States for rural electrification and the furnishing of electric energy to persons in rural areas who are not receiving central station service, as hereinafter provided; to *make,* or *cause* to be *made, studies, investigations,* and *reports* concerning the conditions and progress of the electrification of rural areas in the several states and territories; and to *publish* and *disseminate information* with respect thereto."

REA is then, first of all, a lending agency. The Act provides a total sum of $410,000,000 made available in annual allotments over a period of ten years for lending purposes. This money can be used only for loans. It cannot be used for operating expenses or to make the studies, investigations, and reports provided for in Section 2. Some persons have apparently been under the impression that this total sum is available to spend in the form of subsidies, grants for research, or in almost any other manner which might appeal to the Administrator.

Section 6 of the Act reads: "For the purpose of administering this Act and for the purpose of making the studies, investigations, publications, and reports herein provided for, there is hereby authorized to be appropriated, out of any money in the Treasury not otherwise appropriated, such sums as shall be necessary." Section 11 continues: "In order to carry out the provisions of this Act the Administrator may accept and utilize such voluntary and uncompensated services of federal, state, and local officers and employees as are available, ... "

Thus the Congress in setting up the agency took cognizance of the necessity for providing the technical information essential for doing an intelligent job in this specialized field. They also had the U. S. Department of Agriculture, the agricultural experiment stations, the agricultural extension services and the vocational educational agencies in mind, no doubt, when they authorized the Administrator to accept and utilize such voluntary services of federal, state and local officers and employees as are available.

The Administrator recently wrote the President of the American Society of Agricultural Engineers in reply to your kind offer of cooperation:

"Briefly, I think agricultural engineers can be of great assistance to REA along lines already undertaken by your members. By that I mean through continued research, experimentation on farms, and through training courses. Notable work has already been done in these fields and more will undoubtedly follow.

"We all recognize that ever-increasing usage is the key to the full development of rural electrification. As I see it, the problem of usage is the point where we most need help, and where you and your people are best equipped to pitch in.

"When farm organizations interested in spreading electrification become aware of the high value of research done by agricultural engineers in our universities, they will, no doubt, want to ask legislators to provide more funds for such work. I believe the way to stimulate this farm organization interest is through demonstrations of the kind of service research and experimentation has to offer."

David Cushman Coyle opens the introduction to the new REA booklet, "Electric Power on the Farm", with this quotation from Thomas A. Edison:

" . . . . . I am an old man now. I have lived to see the street car, the elevator, the electrified railroad, the automobile, the phonograph, the motion picture, the radio, the airplane, and the beginning of television. It seems today to many, as it seemed to most men and women in 1882, that no great forward steps remain to be taken.

"It may be that the next 40 years will not produce inventions of such revolutionary character. Progress has been so rapid that we may require a breathing spell in which to consolidate our gains, and develop present inventions to their full capacity. But of one thing I am more positive than I was even 40 years ago—the electrical development of America has only well begun."

The great stimulus REA has given to rural electrification activity has been a factor in bringing about the general lowering of rates and the simplification of rate schedules. The stimulation of line construction has been great. We have faith in the ability of the members of ASAE and of the great educational institutions with which many of you are connected, to develop the practical uses of electricity on the farm, and to teach the farmers to effectively apply them to such an extent that rural electrification may become feasible, on a sound economic basis, to all the farmers of the nation.

We commend the increasing tendency of manufacturers to develop and test their appliances in the laboratories and under the supervision of unbiased research men in our colleges and experiment stations, instead of moving them into the channels of trade with many defects still uncovered. This doctrine of "caveat vendor," as opposed to that of "caveat emptor," seems to us especially important if we are to get the most rapid acceptance of the new applications by the American farmer.

As a former county agent, I am well aware of the excellence of the research and teaching methods developed

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Presented before the Rural Electric Division of the American Society of Agricultural Engineers at Chicago, Ill., December 4, 1936.

Author: Utilization Section, Rural Electrification Administration.

by our agricultural colleges and experiment stations. It was my pleasure to actually have a part in the initial introduction of one of the new electrical applications to the American farmer. We soon found that if we were to get whole-hearted acceptance of the application, we must concern ourselves with far more than the mere functioning of the device itself. This particular application happened to be soil heating. The electric beds had to be ventilated differently from manure-heated beds; the watering practices had to be adjusted; and the proper time of seeding was not the same. To proceed intelligently, we had to be familiar with the practices of the market gardener.

We found the same thing true of electric brooding. But here our ventilating problem was reversed. In the electrified hotbed we discovered that we could get along with less ventilation; with the electric brooder we needed more. The farmer with a new electric brooder who gets a brood of badly pullorum-infected chicks will not likely be an enthusiastic demonstrator of the brooder, even though the brooder itself functions perfectly. The end result of his efforts will be unsatisfactory, consequently he is likely to be soured on the whole process.

The agricultural engineer knows all these problems. He will not likely attempt to work alone in their solution. If he is connected with an agricultural college, he will enlist the aid of his colleagues who are specialists in dairying, poultry, horticulture, home economics, or whoever the specific problem may require. If he is connected with one of the forward-looking type of manufacturers, such as I have mentioned previously, he will also enlist the aid of these other specialists before his company releases the product for sale.

The county agents and home demonstration agents, who play such an important part in getting new practices adopted, have, with few exceptions, had very little training in the use of electricity on the farm. REA money is being loaned in part in areas of low customer density. To make these projects pay out we must rely heavily on the help of the local county agent and home demonstration agent. While they have too many other duties to become rural electrification specialists, yet they should be given enough training so they will be able to counsel and advise the farm people of their county on the sound application of electricity to their farm practice. The agricultural engineers, we hope, will train these county workers in rural electrification just as they have done previously in other subject matter.

The extension agricultural engineer will assist the county agent or home demonstration agent in building a county program of meetings, method demonstrations, tours, publicity material, and other devices that we recognize as effective in getting the job done.

There is a difference in the approach of a research man and a business man to a problem. I am now thinking specifically of the electric fence. Because of some accidents occurring from the use of current for this purpose, and the possible liability of the operating company, coupled with the low energy use that came from this device, the business view seemed to be that we should put this use on the taboo list, shying as far away from it as possible. But that was not the attitude of the agricultural engineer. He recognized the tremendous value of this application to the farmer. He knew that its use would save much time and material for the farmer. He also knew that the usefulness of the practice would be so great that many farmers would use whatever device might be offered for sale or would even try to rig up their own. It was plain, and is still, that farmers must exercise the utmost care in selecting and installing such equipment. So by careful research the agricultural engineer is setting about to build an electrical fencing unit that will be practical, safe, and efficient.

Rural electrification cannot be brought about by one agency alone. But if REA, the agricultural engineers, the U. S. Department of Agriculture, the agricultural experiment stations and extension services, the vocational education people, the distribution agencies, the farm organizations, the state authorities, the manufacturers, the dealers, and last but not least, the farmer who is destined to be benefitted, all work toward that end, we shall see results in the next ten years that possibly none of us here today visualize.

Wind Erosion and Its Control

(Continued from page 198)

area. It is hoped information will soon be obtained regarding the future possibilities of this method.

The danger of soil blowing is greatest during the winter and spring months. Three general factors are responsible: (1) the weathering of the soil during the winter; (2) continuous high winds; and (3) lack of sufficient plant growth and undecayed organic debris to protect the weathered surface soil. Wind erosion should be checked as soon as it starts. Usually the first sign of soil erosion is a little dust rising from a definite location in the field. Later the dust will come from a larger area, and if control measures are not started promptly, the entire field will eventually be blowing. The longer control measures are delayed, the more rigorous they must be. Control measures should be used before blowing actually gets under way. If this has not been done, cultivation serves only as a temporary measure to hold the soil until rain falls and vegetation becomes established. Vegetation such as native grass is the best cover to hold the soil permanently in place.

After a field has started to blow, erosion can best be checked by roughening the surface in strips at right angles to the prevailing winds. A cultivator or spring-tooth harrow may be used for this purpose. A lister is preferable in light, sandy, or loose dry loam soils. One to three lister furrows made every 10 rods usually are sufficient, but the entire field may require listing to stop the soil movement. If the soil is dry and very loose, even listing does not always check soil movement.

In a clean-tilled field enough clods must be brought to the surface to prevent the shifting of fine silt and sands. Dry dusty loam and light sandy soils do not have clods near the surface. Rainfall is needed to pack the surface or the lister must penetrate to the hard subsoil and lift clods to the surface.

Disastrous wind erosion in the future may be prevented throughout the Great Plains when (1) proper land use is practiced; (2) proper and timely tillage is practiced for the recommended crops in the area; and (3) effective temporary control measures are used where conditions indicate soil blowing is likely to occur.

A "Lokator" for Points on Land

By R. H. Denman

THE National Geographic Society—U. S. Bureau of Standards eclipse expedition of June 1936 set up their equipment at a point in Asiatic Russia called "Latitude 51° 1′ N; longitude 55° 39′ E," and received mail with only that designation. A certain boys' camp is at latitude 42° 32′ 1″ N, longitude 73° 57′ 48″ W. By selecting the proper maps and measuring from the nearest parallel and meridian, in each case, the above points may be located and marked. These camps might each be always referred to by the latitude and longitude designation, if there were no better way of giving their location. For the above boys' camp and most other points in the United States, there is a better way even if they are not near any definite landmark.

Parallels of latitude and meridians of longitude 5′ apart are placed on the U. S. Geological Survey topographic maps. These are widely known and used, particularly the size with a scale of 1 to 62,500, each quadrangle of which covers fifteen minutes of latitude and of longitude.[1]

With the latitude and longitude method of locating points on these maps, taking the Albany, N. Y., quadrangle as an example, and the latitude and longitude figures of the boys' camp, we may note the section in which it must be located, then make the proper interpolations and mark its location on the map. While this may be simple and easy for the mariner, navigator, or engineer, for the nontechnical man it is too much figuring with unfamiliar terms. The lines representing parallels and meridians are to him just lines which divide the quadrangle into nine parts. If he were to make use of these lines to describe the location of a certain point, he would naturally start by stating in which of the nine sections[2] it was located. Then, using the scale of the map, he would state the distance from the western boundary and from the southern boundary of the section in miles and tenths (Fig. 1).

Numbering the nine sections of the quadrangle as we read, we would call the one in the southwest corner the

[2]The term "section" as here used should not be confused with the term used by the public land survey to designate a part of a township.

Author: Supervisor of rural service (Albany district), New York Power and Light Corporation. Aff. ASAE.

[1]The Federal Board of Surveys and Maps, Washington, D. C., can supply full information on the plan and progress of mapping of the United States.

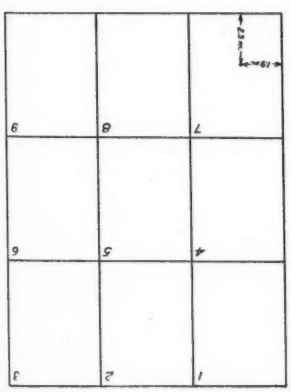


FIG. 1 (ABOVE) METHOD OF NUMBERING THE SECTIONS OF A USGS QUADRANGLE. A POINT MAY BE DESIGNATED BY ITS POSITION IN ONE OF THOSE SECTIONS, AS SHOWN

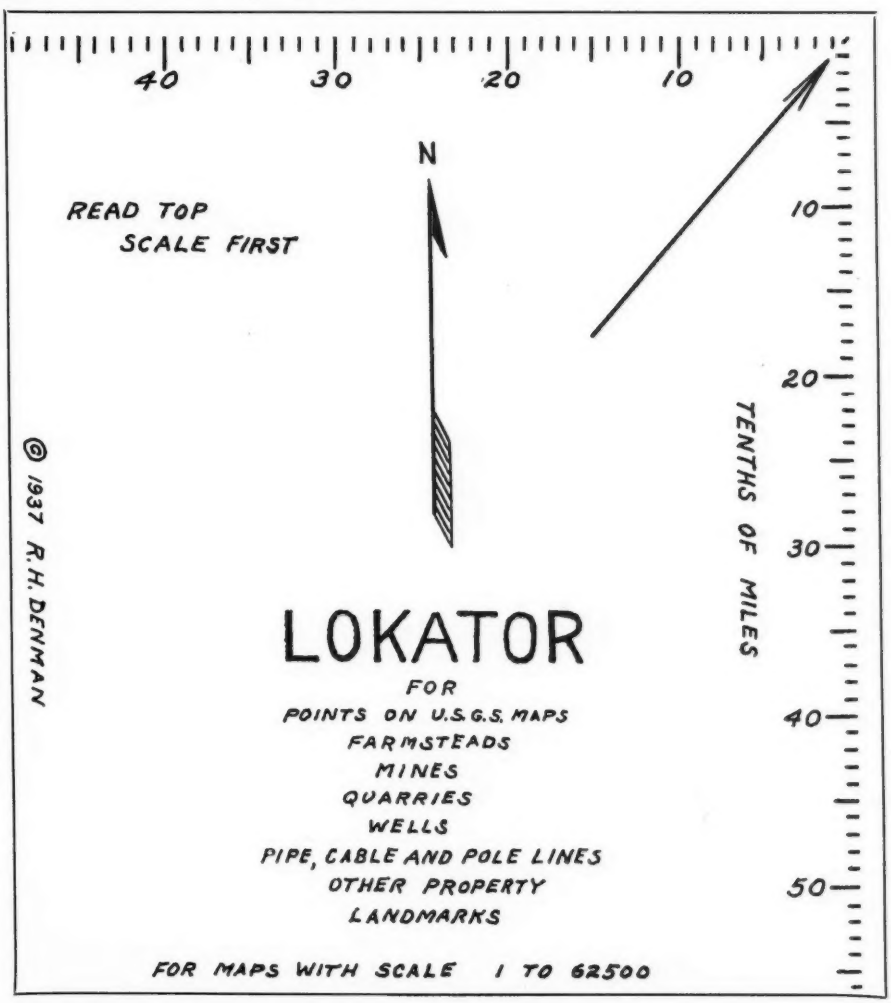


FIG. 2 (RIGHT) LOKATOR AS USED ON USGS TOPOGRAPHIC MAPS OF THE SCALE OF 1 TO 62,500

seventh. Describing the location of the boys' camp we would say it is 1.9 miles from the western side and 2.3 miles from the southern side[3]. The complete location designation for this point might be abbreviated to N. Y. Albany-7-1.9, 2. 3. For comparison the latitude and longitude for this point are 42° 32′ 1″ N latitude, and 73° 57′ 48″ W longitude.

An abbreviated but accurate method of locating and designating points on the USGS maps, without using the terms latitude and longitude, I have called the "lokator" method. The success of such a method depends upon its standardization under a definite name, or under a name and by a device designed to make measurements easy and accurate.

I have designed, and have for a considerable time used, a lokator device which makes it possible to quickly and accurately determine the "location number" for any point on a USGS map, or having the location number, to easily spot the location on the map. It is made of cardboard or other suitable material, cut in the form of a rectangle about the size of one of the sections of the quadrangle (Fig. 2). A height of 5.82 in will do for all latitudes, but the width must be 5.00 in[4] to be used on Texas and Florida maps, although only a little over 4.00 in is needed for the northern tier of states. A scale of tenths of miles is marked along the upper edge and along the right-hand edge, beginning at the upper right-hand corner in each case.

In use, to determine a location number, the lokator is placed on the map so that the upper right-hand corner touches the desired point (Fig. 3). The number which is cut by the meridian on the upper or X scale is noted first, then the number which is cut by the parallel on the right-hand or Y scale is noted. Suppose the X scale shows 21 and the Y scale 46 on the ninth section of the Cohoes, N. Y., quadrangle. The complete designation would then be "N. Y. Cohoes-9-21,46".

Suppose now that the location number is given and it is desired to find on the map the point designated. The Cohoes, N. Y., quadrangle is spread out and the lokator placed on its ninth section so that 21 on the X scale is on the meridian and 46 on the Y scale is on the parallel. The point desired will be at the upper right-hand corner of the lokator.

It will be noted that the decimal points used in the first writing of a location number in this article were omitted in the last illustrative example. They were used at first to show the development of the idea, as they were also actually used in practice for a time. They are now omitted to simplify the writing and speaking of the numbers. These numbers can always be reduced to miles by pointing off one place. Another advantage is that, while in general it would not be needed, a decimal point and digit might be added to distinguish between two points which the lokator might give the same number. For example, two farmsteads, one exactly across the road from the other, might each be given the location number "N. Y. Albany-5-25, 28". To distinguish between them for filing or other records one could be "N. Y. Albany-5-25.1, 28", or "N. Y. Albany-5-25, 28.1"[5].

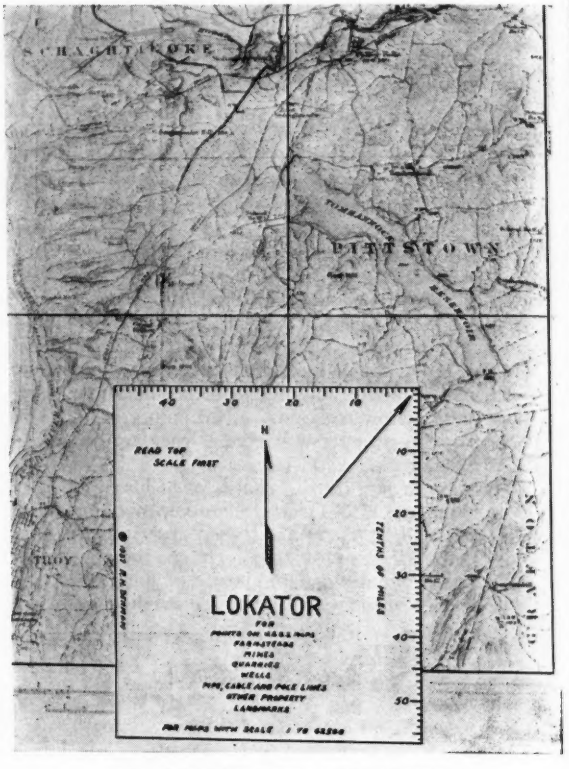


FIG. 3 LOKATOR IN PLACE ON MAP

It will be seen that, for whatever kind of property or landmark the location numbers are used, they not only give the location but also are a reference, file or identification number.

They may be used by various public or commercial agencies for identifying farms[6], for example, by the farm bureau and the state agricultural extension service. The complete address for each member farm would consist of the operator's name, post office and location number. Then the operator could not only be reached by mail but could be easily found by any field worker. For example, the poultry specialist from the college who wishes to call on the poultrymen of the county for some service or inspection, needs for a guide only the lokator and map. By the old method he must be carried about by someone from the farm bureau, generally the manager himself, who thus

[3]This conforms to the standard coordinate system used in mathematics, the positive quadrant being used and the abscissas or "X" quantity being read first. It also conforms to the co-ordinate method of surveying and plotting.

[4]A lokator for maps of a different scale than 1 to 62,500 would have to be dimensioned accordingly.

[5]It may seem to the reader that tenths of miles is not a fine enough division on the lokator. If desired, hundredths of miles between the tenth divisions may be estimated and written to the right of a decimal point. We might even use a vernier, but then we would be attempting an accuracy in the lokator greater than that of the map on which it is used. Practically no case will be found where reading to the nearest tenth will not be accurate enough. Then, too, standardizing on the tenth-mile basis simplifies the location number and the use of the lokator. In an emergency, no lokator being available, the scale of miles and tenths on the map may be used.

[6]There are some sections where farms are located on named roads with street signs on the corners and house numbers visible from the road. In such sections the lokator system may be needed only for filing purposes. But until there is nearly complete coverage by the urban system, plus a rural system of house numbering, there will be need for a system of location numbers.

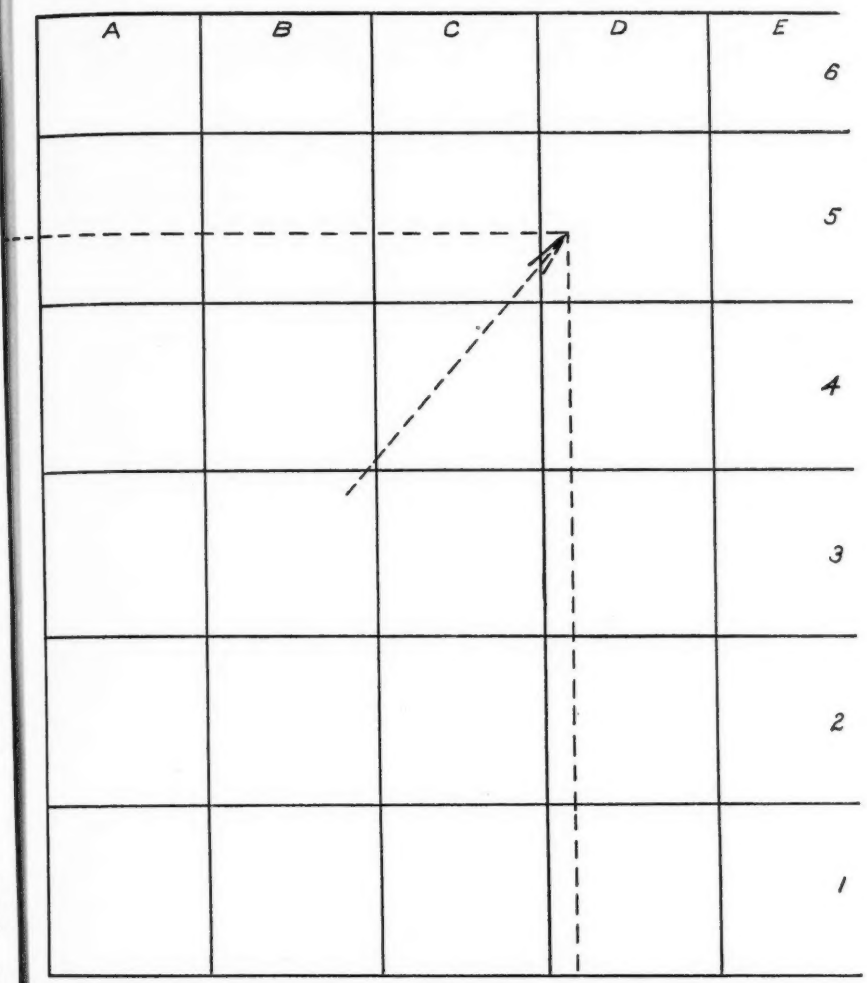


FIG. 4 DRAWING NUMBER CHART TO BE USED WITH LOKATOR

spends time which might more profitably be used in some other way.

Farms cooperating with the U. S. Soil Conservation Service, or which are on the records of any of the land-planning or land-use agencies of the United States, could be identified by a location number. The use of such a number instead of a name only, in addition to its other advantages, avoids confusion in the case of change of ownership.

Such a system can be used in real estate transfers. When officially adopted it can be used for taxation records and in the recording of deeds, mortgages and other papers relating to land. The federal land bank, and other banks which make loans to farmers, would find it useful.

The "lokator" system may be used also for mines, quarries, isolated oil or gas wells, and the routes of pipe lines and electric lines. I have found it particularly useful, in rural electrification, in designating the origin and termination of new electric lines. When lines are identified by location numbers, reference may be made to them by mail or over the telephone without confusion and with accuracy. A field worker may call the engineering department over the telephone from a distant office or other point giving the location by number of a line about which he wants information. The employee in the engineering department, by applying his lokator to the "drawing number chart" (Fig. 4) can tell immediately the number of the drawing covering the location about which the field worker wants information. Suppose, for example, that the request is for location Albany-3-32,44. Applying the lokator to the drawing chart (Fig. 4) he sees that the drawing desired is Albany-3-D5. This may be immediately found in the drawing file, without any time being wasted in referring to a cross index or in hunting through a stack of drawings[7].

Where this system is in use, each employee in the engineering department and others, who have contact with them, have a lokator within reach. The drawing chart is needed only by those who have access to the drawing files. The drawing chart illustrated provides for drawings covering about one mile each way. This, of course, can be varied and the symbols as well.

I have outlined a few of the ways in which the *Lokator* system may be used advantageously. There may be many others. Any reader may find an adaptation of it for his particular line of work which may not occur to anyone else.

[7]The New York State Library has indexed the quadrangles covering the state, the tiers being designated by letters and the columns by numbers, so that the Albany quadrangle is J24, Troy is J25, Kinderhook is K25, etc. At least one large organization in the state is using these designations instead of the quadrangle names. The drawing number is thus shortened from Albany-3-D5 to J24-3-D5.

Engineering Problems in Air Conditioning

By Samuel R. Lewis

AIR conditioning means, to the popular mind, air cooling. In engineering circles it means very much more. Originally engineers believed that it meant controlled moisture content in the air.

The process of dehumidification is utilized in all complete air conditioning systems. To reduce the relative humidity of air is to aid in evaporating moisture from the body and increase the effectiveness of the bodily temperature-reducing mechanism.

Ordinarily a man sitting in a comfortable room gives off about as much heat as a small tallow candle. This is why when a room is crowded with people, the room so quickly becomes hot.

Salesmen for humidifying apparatus have attempted to make people believe that when the air of a heated room or house is moistened artificially there will be a tremendous saving of fuel. This is a fallacy, because water cannot be made to enter the air unless the heat necessary to a change of state, from water to vapor, is furnished.

It is true also that the artificial moisture introduced into heated rooms in cold weather will condense out of the air against any surface of the room which is cooler than the dew point temperature of the mixture of vapor and air. It is impracticable, therefore, to maintain within a heated room a relative humidity as high as the normal outdoor summer relative humidity of about 50 per cent, when the outside temperature is cold. Only when double windows and well insulated walls are provided can the cool surfaces be prevented from reaching a temperature low enough to condense moisture. If the glass surface is colder than 45 F (Fahrenheit) moisture will obscure it when the interior relative humidity is 40 per cent or higher.

The old-time farm home, the old-time dairy barn, and the old-time horse stable all were sealed up for the winter so as to retain animal heat. Modern dairy barns, even in cold climates, always are ventilated with outside air. Modern poultry houses all are ventilated. Both return high dividends in milk and eggs, and in health.

Horse barns which were not ventilated have nearly suffocated the animals, and the high relative humidity in the air, from the body moisture given off by the animals, has caused rotting of the walls and roofs, due to the water condensed against their cool surfaces.

The farm house in the old days had a big fireplace and the relatively enormous open chimney removed so much air that the air condition was good, even though the family was chilly most of the time. Benjamin Franklin, realizing the inefficiency of the open fireplace as an air heater, enclosed its throat in cast iron and provided a grate and air recirculating flues. Franklin patented his stove and presented the patent to the public, thus becoming the patron saint of all heating engineers.

Franklin's efforts did much to encourage low relative humidity in houses. Evaporation from the bodies of people increases the heat dissipation from their bodies. They have to drink more water to supply the water and have to eat more to furnish the heat to evaporate the water, all of which may be stimulating and desirable, even though some people think it is wasteful and ultimately harmful.

It has by no means been proved that any particular discomfort or shortening of the life span of most humans results from failure to provide artificial humidification during the winter. It appears that the compensating arrangements of normally healthy people are capable of adjusting the heat output rate in accordance with the air condition.

When it comes to cooling rooms in summer, however, these compensating arrangements are often seriously overtaxed, and one has but to remember the drawn, thin look of some Southerners at the end of a hot summer to appreciate the enervating effect of too many successive hot days and nights.

Such people have endured so many hours of moist hot air against their skins that the bodily cooling mechanism, which works by evaporation of moisture, is fatigued.

If the air which comes against the skin could be dehumidified, even though it were not cooled particularly, there would be a very great improvement in health and comfort. Air can be dehumidified by passing it in contact with an adsorber which mechanically picks out the water vapor. Silica gel will do this trick. Common salt is an adsorber. There are many of these. Unfortunately the change of state from vapor in the air to water in the adsorber releases heat and this heat warms the water and the adsorber and all of their surroundings. The air emerges very dry, it is true, but also much hotter than when it entered the dehumidifier. This is the reverse procedure from that which makes it necessary to apply heat to air when humidifying to compensate for the heat required for changing water to vapor.

If an adsorber is used to dehumidify air, therefore, it still is necessary to employ refrigeration to cool the air. There is merit in many cases, in a combination of adsorption and refrigeration, particularly since the refrigeration in this case need not reduce the air temperature to the dew point.

The most widely employed method for dehumidifying is to reduce the air temperature below the dew point to compel it to deposit its moisture, and then to keep it cool until it enters the room which is to be cooled.

Refrigeration may be obtained from cold well water. Sufficient refrigeration to cool an ordinary farm house may be obtained from the well, provided the well water is cooler than around 55 F and provided there is a reasonable supply of it. This cool water may be pumped through a device like an automobile radiator placed in the room or in a duct leading to the room. The cooling will be more effective if there is a fan to drive the air rapidly through the convector, but an overhead water-cooled convector will accomplish appreciable dehumidification and cooling if the openings in the room for air circulation are higher than the convector, and if the openings in the room below the convector are kept closed. Successful comfort cooling of sleeping rooms has been achieved by cooling the bed only. An air-tight fence of any suitable material, such as fiber board, is built around the bed. The cooling convec-

(Continued on page 206)

Presented before the Farm Structures Division of the American Society of Agricultural Engineers at Chicago, December 1, 1936.

Author: Consulting engineer and specialist in air conditioning.

New Principle in Threshing Lima Bean Seed

By Roy Bainer and J. S. Winters

CALIFORNIA produces annually several million pounds of both large and small lima bean seed. Much of this goes to eastern states, where it is used for market-garden or canning crops.

Difficulty has been experienced recently in securing good stands of lima beans because of poor germination. Investigations[1, 2, 3, 4] have shown the cause to be mechanical injury during threshing or handling.

Growers have long recognized that some damage exists in almost all lots of machine-threshed beans. Generally, however, they have not understood that besides the visible damage there may be an even larger percentage of internal damage that cannot be detected until germination. The visible injury consists of split beans and cracked seed coats. This, though affecting several per cent of the crop under some threshing conditions, is less serious, from the seedman's viewpoint, than the internal damage, because the obviously injured seeds can be recognized and removed when the beans are sorted at the warehouse.

In a more serious type of thresher damage, only the internal structure is broken. As seeds thus injured appear perfectly normal, the evidence is not found until germination. Thus the defective seeds cannot be picked out even when known to be numerous.

A bean seed consists of a small dormant plant surrounded by a very thin seed coat. During germination this dormant plant resumes growth, bursts the seed coat, and develops into a seedling. Obviously, since all these structures are present in the seed before it germinates, they may be damaged by threshing or cleaning.

Authors: Respectively, assistant agricultural engineer, (Assoc. Mem. ASAE) and associate in agricultural engineering, University of California.

[1]Whitney, W. A., Mutilated seed—a contributing factor in defective stands of lima beans (abstract). Phytopathology 20 (1): 134-135, 1930.

[2]Harter, L. L., Thresher injury a cause of baldhead in beans. Jour. Agr. Research 40:371-384, 1930.

[3]Borthwick, H. A., Thresher injury in baby lima beans. Jour. Agr. Research 44:503-510, 1932.

[4]Bainer, Roy, and H. A. Borthwick, Thresher and other mechanical injury to seed beans of the lima type. Calif. Agr. Exp. Sta. Bul. 580, July 1934.

Beans injured internally produce seedlings in which certain parts are missing or defective. Often seeds may be so shattered internally as not to germinate at all. If they are germinated, the damage is shown immediately. One should remember, however, that injured seeds cannot be detected before germination.

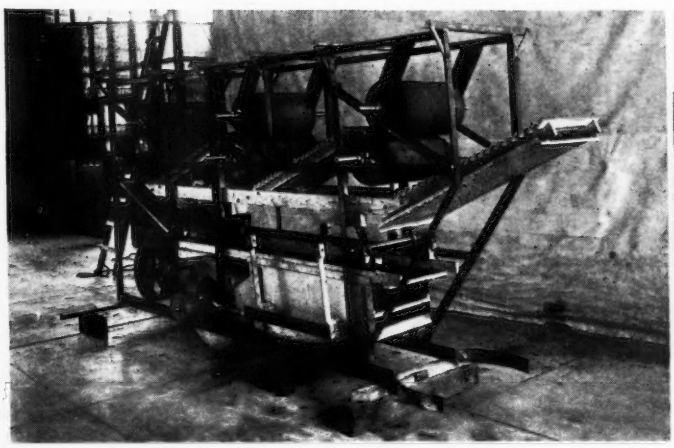
The two widely recognized injuries are the so-called "baldhead" and "snake-head" types. In the former the stem growing-point and the first true leaves are missing; in the latter the two cotyledons have been detached. Such seedlings seldom produce a crop of any importance. Other injuries consist of broken roots, stems, cracked cotyledons, and complete shatter.

Preliminary to the development of a new principle of threshing, a study was made of the commercial threshers in the field to determine the extent of the damage. Samples taken from the machine were used for moisture determinations and germination trials, while hand-threshed samples from the same field served as checks. All the machine data, including speeds of different parts and clearances, were obtained. This study indicated that the thresher caused most of the damage. It was hard, however, to get a correlation of damage with cylinder speed and moisture content in any study of commercial machines.

In this preliminary study, a regular bean cylinder and concave unit was mounted on a truck for further field trials. With this unit the cylinder could be driven at various speeds, samples for germination being taken after each run. A range of five speeds varying from 770 to 1,560 fpm (feet per minute) was selected for all the runs. The total damage to a lot of baby limas containing 9.1 per cent moisture was 7.6 and 52.5 per cent for speeds of 770 and 1,560 fpm, respectively. The former speed was too low for any commercial application. Most commercial machines were found to be operating between 1,150 and 1,350 fpm. For these particular speeds the damage was 25.0 and 40.6 per cent, respectively.

These preliminary investigations lead to the conclusion that the standard bean thresher was unsatisfactory for threshing seed beans and that some new device should be developed.

When the beans were in condition for threshing, a



(LEFT) A VIEW OF THE EXPERIMENTAL BEAN THRESHER DURING CONSTRUCTION. (ABOVE) THE COMPLETED MACHINE READY FOR FIELD TRIALS

slight pressure on the pods distorted them sufficiently to cause them to open along the seam. When this pressure was released the pod separated, throwing the beans out. Several different devices were built accordingly, to accomplish this result. Finally a set of rubber-covered steel rolls approximately 1 ft in diameter were tried. When the straw was passed through a set of these rolls, 80 per cent of the beans, on the average, were given up the first time through; 15 per cent the second; and 2 to 4.5 per cent the third. The total thresh was, therefore, 97 to 99.5 per cent. With beans that had been cut only 24 hrs, results were similar, because the bean pod is the first part of the plant to ripen. The chief reason for delaying the threshing after cutting is to allow the straw to dry sufficiently for the cylinder to handle it.

As a result of the preliminary investigation, a complete machine embodying this principle was designed and constructed (See accompanying illustrations). Since practically all the beans could be threshed by passing the straw between the rolls three times, a machine having three sets of rolls was expected to prove adequate. The rolls were made the same size as those in the machine used in the preliminary trials. In fact, the same two rolls were utilized. All but two of the rolls were covered with 0.5 in of soft rubber (flotation stock). The two exceptions had 1 in of rubber vulcanized to them. They were used for the lower rolls in the first and second set. Thus a 1.5-in rubber cushion protected the large percentage of beans threshed by these two sets.

The first and second set of rolls were driven at a peripheral speed of approximately 210 fpm; the third set at 250 fpm. These speeds are about 15 per cent of the minimum cylinder speeds found in commercial seed-bean threshers.

The rolls were mounted in pairs on 4-ft centers. The lower roll of each pair was positively driven, whereas the upper rolls were driven by contact through the bean straw passing between them. The bearings on the upper rolls were mounted in guides that permitted them to rise sufficiently to give a 3-in clearance between the two rolls. The center of the upper roll was 6 in behind the center of the lower, an arrangement that improved the feeding characteristics of the rolls.

Each end of the upper rolls in the first and second set was loaded with compression springs having a constant of 50 lb per inch of deflection. The initial loading was the weight of the rolls plus 100 lb of spring pressure. The upper roll in the third set was loaded with two springs having a 20-lb constant; here the initial loading was the weight of the roll plus 40 lb of spring pressure. In each case, because of the characteristics of the springs, the pressure on the rolls increased as they were lifted by the bean straw.

The straw racks, grain pan, chaffer, and cleaning shoe were all of conventional design. A drag-type belt elevator, running at 160 fpm, returned the unthreshed pods to the second set of rolls. The clean seed was conveyed to the opposite side of the machine on a horizontal belt conveyor to a cup elevator. From there the beans were elevated vertically and discharged into a small sacking bin. The elevator operated at a speed of 105 fpm.

A modified pickup, shortened to 39 in, was used for picking up two rows of beans just as they were left by the bean knife. Immediately behind the pickup, converging sides narrow the material down to 19 in (the width of the elevating drapers and machine). Two slatted canvas drapers elevate the beans from the pickup to the first set of rolls.

The machine was mounted on three wheels. The under carriage in front consisted of a complete automobile rear end. The wheel in the rear was a front wheel from the same car. Mounted in a turntable, it served as a tiller for steering the machine in the field. A hitch, which could be attached to the rear wheel, made it possible to trail the machine on the highway.

Power for operating the thresher, as well as for propelling it in the field, was furnished by a Model T Ford industrial unit mounted on the left side of the machine. Field speeds of 0.5, 1, and 2 mph (miles per hour) could be attained, through the use of a three-speed transmission, when engine was running at 1,200 rpm (governed speed.)

All parts of the machine, aside from the fan, operate at speeds below 300 fpm, which is the velocity attained by a free body at the end of a 4.5-in fall. Consequently, damage by impact is eliminated.

According to blanket tests run on the harvester, better than 99 per cent of the salable beans taken into the machine were threshed. The moisture content of the beans varied from 11.4 to 13 per cent. The visible damage was less than 0.2 per cent; the internal damage, as reported by the botany division, 1 to 4 per cent.

Samples for analysis were taken from a two-cylinder thresher working in the same field. The cylinder speeds were 1,110 and 1,580 fpm for the first and second cylinder, respectively, slightly below the speeds encountered in most commercial machines. The machine was in excellent adjustment. The moisture content of the beans was 10.8 per cent. The visible damage was 4.11 per cent; the internal damage to the remaining good beans, 14.7 per cent. The total damage to the whole lot was 18.16 per cent, which was less than the average found in previous studies because this machine was in good condition and was operating at a low speed.

Engineering Problems in Air Conditioning

(Continued from page 204)

tor is placed at one end of the enclosure so that the cooled air may fall of its own weight down into the box. The top is entirely open to the room, and the room may have as many windows open as possible, so as to take advantage of the usual night cooling.

This device may employ pumped well water, or the ordinary large-sized food refrigerator condensing unit may supply refrigerant to the cooling convector. Ice may be melted in a tank of water which circulates through the cooling convector.

Too many housewives provide heavy roller shades and portieres to cover the upper parts of windows in bed rooms. Few bedroom windows have fly screens over more than the lower half of the opening.

An electric fan in an attic window, pulling air from ceiling registers, or even through open transoms from the room, via the windows and through the halls, will promote comfort during the night, and if stopped in the morning so as not to bring in heated air, is a good investment.

The old stone houses with thick walls, rarely seen in this country, generally are comparatively cool in summer because of their great capacity for heat storage. Before the solar heat has time to travel through such walls they are again in the shade, and the heat thereupon commences to be reabsorbed by the outer air.

For this reason all buildings should have heat insulation which, in modern construction, simulates the effect of the old-fashioned thick walls and roofs.

Rootbed Versus Seedbed

By G. D. Jones

STUDY of the soil and its extremely important function in relation to plant growth is vitally necessary to successful agriculture.

There are two commonly accepted factors which govern the growth of plants. The first is climatic, which includes sunshine, precipitation, and temperature. The second is edaphic, which includes the chemical, physical, and biological processes occurring within the soil. Both the climatic and edaphic factors must be in synchronism to produce crops of high quality and quantity yields. When these two factors are out of synchronism, it is clearly and definitely reflected in growth and yield.

Much has been written about the climatic factors in relation to plant growth, but since man has little or no control over the amount of sunshine available, or the temperature, or the amount of moisture provided by nature, we can do little about it.

But when we look into the history of the edaphic factors, we will find in most instances a discussion of fertilizers and fertilizer placement. This history dates from Leibig's time, or perhaps from Bernard Pallissy, who in 1563 developed and gave to the world the first crude principles of selective requirements. Leibig, however, is credited with the theory on which modern fertilizers are based, namely, that great trinity of nitrogen, phosphorus and potassium. We have, of late, heard about the necessity of other elements, such as manganese, magnesium, boron, copper, iron, and sulphur. In fact, some discussions have brought in all of the soil elements, about thirty-six in number.

I am of the opinion that we are still endeavoring to put a jig-saw puzzle together, but somehow it just will not go together. Something is missing, and just what that something is no one seems to know.

The chemist has one theory, and perhaps he is correct as far as he goes. The physicist has another, the biologist another, and perhaps the agricultural engineer another, and each is working in his own field. Therefore the results of research developed by the chemist relate to chemical action, the physicist's findings are held within the bounds of physics, the biologist's to biology, and the agricultural engineer's probably within engineering lines. When we are all through, we find ourselves about where we started.

I do not presume to belittle in any way the research that is being carried on relative to agriculture, nor do I desire to imply that no real results are being or have been accomplished, but what I do believe is that we are taking separate roads, which lead us apart rather than draw us toward a common goal.

I believe it is inevitable that engineering should go hand in hand with pure science. There are occasions in which you will find science and engineering closely allied, but in the majority of instances these two branches of endeavor are miles apart. Where it should be science and engineering, you will find that it is science versus engineering, and so we come to the subject of this paper, namely, seedbed versus rootbed. Should it not be seedbed and rootbed?

A seedbed is something in which a seed will germinate or sprout, but not necessarily grow into a full and fruitful plant.

A rootbed is something in which roots of plants can expand and grow, and wherein energy is provided that will, through the root system, provide the necessary elements for the growth of plants.

I am sure, therefore, that when these two definitions are analyzed, it will be found that, in order to produce successful plant growth, it is necessary to have a combined seedbed and rootbed, rather than a seedbed or a rootbed.

When soil was first cultivated for crops, man was working with virgin soils, and therefore the requirement for a scientific treatment of the soil was not necessary. Nature had prepared the rootbed and man prepared the seedbed.

The term "rootbed" was originated by John A. Slipher of Ohio State University some years ago, and his description is worthy of considerable thought and study.[1]

Rootbed, as a term, has or should have a certain psychological effect on anyone interested in soil tillage. It makes one more conscious of the fact that plant culture is more than placing seed in the top few inches of soil. It makes one conscious of what is going on beneath the surface of the soil, conscious of that marvelous root system, so active yet not seen.

How many of us truly understand the relation of soil to plant growth? I have yet to find one. If you can find a man who does completely understand this relationship, then immediately all guesswork as to chemical requirements will be eliminated and we will have definite knowledge as to the correct combination of chemicals to be placed in any given soil for any given crop to be planted. In other words, we will have exact knowledge as to the plant requirements.

Volumes have been written on the subject of fertilizers. Experiments have been in continuous operation at Rothamsted (England) since its founder, Sir John B. Lawes, first started his original test plots in 1837. But we still have no exact scientific knowledge as to plant requirements. It can truly be said that exact scientific knowledge of soils in relation to plant life is indeed lagging sadly behind the march of science. Why? In the first place, research is lacking, and, in the second place, the student is lacking. I am afraid we are too content to play along with the cut-and-try method, which is so easy to do.

Now let us discuss a few phases of this research subject. In the first place, it is well known that man is composed primarily of moisture plus some thirty-six elements, and it also is a fact that the very same thirty-six elements, plus a few more, comprise the soil. It is, therefore, good reasoning and logic to assume that, since all plant life requires soil in which to grow, these elements must have or perform some function in plant growth. If a portion of these elements are lacking in the soil, it appears to me that we will get a reaction. That reaction is reflected directly or indirectly in the plant itself, during its growing period. Most

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Author: Patent counsel and agricultural engineer, Cleveland Tractor Company. Mem. ASAE.

[1] "The Mechanical Manipulation of Soil As It Affects Structure," by John A. Slipher, AGRICULTURAL ENGINEERING, vol. 13, no. 1 (January 1932).

of our farm crops are produced for the purpose of supplying food for man and beast. The mineral or chemical element not present in the soil certainly cannot be present in the plant, and so man is deprived of this element, and undoubtedly it must follow that sooner or later the lack of this element is reflected in the man or beast, as the case may be. And sooner or later the effect will become apparent in the form of disease or ailment.

For example, we have tested many samples of soils taken from lettuce fields, which showed no trace of iron or manganese, and yet lettuce should contain a large proportion of these elements. One may as well take a glass of water instead; it would probably be more beneficial.

There has been some research on the problem of the deficiency of these, sometimes called rare elements in plants. If the plants show a deficiency, the soil must be deficient.

DETERMINATION OF PLANT REQUIREMENTS

The thing that concerns me is how we are to determine the plant requirements of each of these elements, as an oversupply may be as bad as an undersupply. It is common practice to say that plants are soup eaters, and yet no one has ever discovered a digestive organ in a plant. We are well acquainted with the structure of plants. We know that they are composed of cells, that each cell is divided from the other by a membrane structure. Moisture passage from one cell to another we call osmosis. However, after long experimentation and research, it appears that this action is purely electrolytic.

If this is the action of electrolysis, then we can work back to the soil function and can determine the action taking place therein.

We know that the mineral and chemical elements in the soil are either negatively or positively charged. It must follow that the plant is living in a soil that is generating electrical energy. What relation is there then between the growing plant and the energized soil in which it grows? Surely no one can say that there is no relation. There must be, for the scientists in their research are discovering that practically all action is produced electrically. I agree with the statement in Prof. Furnas' book "The Next Hundred Years," namely, "Yet water, soil, seeds, nitrogen, potassium, and phosphorus will not raise plants. We are just beginning to realize how many other important factors there are. We are beginning to realize how little is known on the subject." For several years I have worked on this most interesting and fascinating problem and am confident that this research is leading into a clear and understandable knowledge. The principal object of this research is to discover or find a way to measure the demand of the plant, and when this becomes a reality rather than a theory, agriculture will then be a real science.

Let me for a moment, and very briefly, touch on a subject very dear to me, deep tillage. This works in with the subject just discussed, soil action. For years we have used the plow to turn the soil, the slice varying in depth from three to seven inches, and, in a few locations, down to ten or twelve inches. The result of the plowing has produced a plow pan of compact soil; in other words, packed soil, truly a seedbed and not a rootbed. This soilbed has been depleted of humus, the water-holding means of the soil, and since we have compacted the soil below the bed, it is difficult for water to percolate into the subsoil where it belongs. So it takes the line of least resistance and runs off on the surface, taking with it a small or large amount of surface soil, depending on the speed of movement. The result, erosion!

It seems apparent, and certainly very logical, that if the plow pan were fractured and made porous, water from rainfall or snow would naturally percolate rapidly into the lower stratum of the soil. It also appears logical that if decayed or decaying vegetation, commonly called humus, will retain from eight to ten times its weight in moisture, as it does, and that if this humus were thoroughly mixed throughout the bed, we would have stored up reserve moisture for the summer months. Just why there is any argument against this procedure is beyond my comprehension. One of the sad mistakes so often made in farming is the plowing under of a green manure crop. To me it is like putting green hay in a mow. The result is fire, and the remains are ash. The same result is accomplished when a green cover crop is turned under. In a short time we find nothing but ash. Seldom, if ever, is any humus left. We find a pulverized soil bed, void of any organisms; and the result is wind erosion when dry, and soil runoff from rain. Why not distribute the crop throughout the rootbed, and thoroughly mix it with the soil? Would it not be well for us to do a little research on this subject?

I like to think of the rootbed as a gigantic battery, the soil particles being the electrodes; humus, the separator plates; moisture, the solution; the roots connected to the electrodes, and acting as conductor to the motor, the plant.

Have we studied the colloidal action present in soils? It certainly is an absorbing research. The Brownian movement, ever active, in soils that contain the correct elements? What of the electron and protron which make up the atom? This action is going on in the soil as well as above the soil. Dr. Rabbi of Columbia University and his associates have journeyed into the inner citadel of the hydrogen atom, and since hydrogen is the larger element of water, the electron and protron in water are not dormant. The magnetic moment of the electron has been found to be always negative, while that of the proton and of the deuteron has been found to be always positive. This results in electrolytic action. And so it is with the atoms of other elements, a continuous action of energy producing particles, and the roots of the plants grow in this activity. To discuss this subject in detail would require hours and perhaps days, so I have just touched it with the hope of creating an interest from an agricultural viewpoint.

TRAINING REQUIRED TO PROMOTE AGRICULTURAL PROGRESS

In conclusion, it appears necessary to consider revising our educational system. Just as we must emancipate tradition from agriculture, so must we emancipate tradition from education.

In a paper read before the celebration of the centennial of the American patent system, Dr. R. E. Wilson said, "While I look for chemical inventions to continue for many years their amazing rate of increase, I believe that the particular fields in which the number of important inventions is likely to increase most rapidly during the next century are in the fields of medicine and agriculture, particularly as research in these fields is taken up more and more by highly trained scientific specialists, rather than by men trained along conventional medical and agricultural lines."

And so the work of the agricultural engineer, in my opinion, should be done on purely scientific lines. It certainly cannot be denied that we need men trained in electrobiochemical engineering, as these men must unravel the mysteries of the greatest electrochemical factory of all time, the farm soil.

Farm Requirements of the Small, All-Purpose Tractor

By B. R. Benjamin

THE small general-purpose tractor should meet all requirements for plowing, planting, cultivating, and harvesting on corn belt farms of a size suited to its plowing capacity, replacing three to six horses.

In the cotton producing districts it should meet these requirements on about the same acreage, except for harvesting.

On truck farms operations of planting and cultivating may be practical only on row crops with spacing of 20 in or over, or alternating wide and narrow spacing, as on lettuce beds.

It can be stated as a basis of discussion that the small general-purpose tractor should be the principal power on farms from ten acres to one hundred acres.

Farms from ten acres to fifty acres will be largely in truck crops, or a combination of truck, fruit, and general crops. Farms of fifty to one hundred acres may have, in many cases, a combination of general crops and crops used for dairy feed.

Floral crops and nursery plants grown in the open, also tobacco and other transplanted crops, influence equipment as to special features.

Additional use will be found for small tractors on larger farms in combination with one or more larger tractors, where the smaller tractor will be used mostly for light work, such as planting, cultivating, and mowing.

The power required will be determined by the time limit on operations of plowing, planting, cultivating, and harvesting the diversified acreage on farms ranging from ten acres of truck crops to the larger acreage of corn and cotton on farms near one hundred acres in crop area.

In the corn belt the conditions will vary with soil and climate, and the same drawbar pull may operate one 14 or 16-in plow 7 or 8 in deep, at 2.5 to 3 mph (miles per hour), or two 10 to 14-in plows at a depth of 5 to 6 in at the same speed.

We believe it will be seen that the power must be sufficient to operate a two-row cultivator in corn at a speed of 4 mph in later cultivations, when plants are higher.

On farms of near one hundred acres the same power must operate the grain binder, the corn binder and hay tools, and have a reserve, on low speed, for muddy ground and extra pull on hills.

This small tractor must be powerful enough for belt work operating small grinders and small ensilage cutters, etc.; and should have a power take-off available for corn and grain harvesters and potato diggers.

Requirements for planting and cultivating a large variety of row crops have determined the design of the general-purpose tractor, as to dimensions and wheel base, and the adjustment of rear wheels must be based on row spacings of beets and truck crops of 20 to 40 in, center to center, and corn and cotton 36 to 44 in center to center.

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Author: Assistant to manager, engineering department, International Harvester Company. Mem. ASAE.

Reasonable clearance is required under rear axles for corn and cotton. Short turning and easy steering are necessary for efficient operation. In the southeastern states it is desirable to operate tools for bedding and planting and applying fertilizer all at one time. In potato districts the power must be sufficient for planters, heavy two-row cultivators, and one-row diggers, where row spacing varies from 28 to 42 in.

Row spacing variations on account of soil and climate and methods of farming are, for corn, 36 to 46 in; cotton, 36 to 46 in; potatoes, 28 to 42 in; beans, 20 to 40 in; beets, 20 to 28 in; and truck crops, 10 to 60 in. Lettuce beds are 40 in, center to center, with rows on beds spaced 12 to 16 in apart.

Plows on one hundred-acre farms in the corn belt may be of the moldboard type, either trailing or direct connected; while in the cotton territory, generally some type of disk plow, middle breaker, or lister is used.

Terrace work, and operating planters and cultivators on terraced land, must be considered in cotton territory, and to a limited extent in the corn belt. Here the problems arising from operating on steeper slopes must be solved to make tractor farming successful.

It must be evident that the success of the so-called small all-purpose tractor design depends on the best design of implements for plowing, planting, cultivating, and harvesting of row crops, with power take-off available, and with pulley for belt work.

The maximum power is largely based on operating a two-row cultivator up to 4 mph, and operating grain binders and corn binders at 2 to 4 mph, with some reserve for bad conditions of ground and extra power for hills.

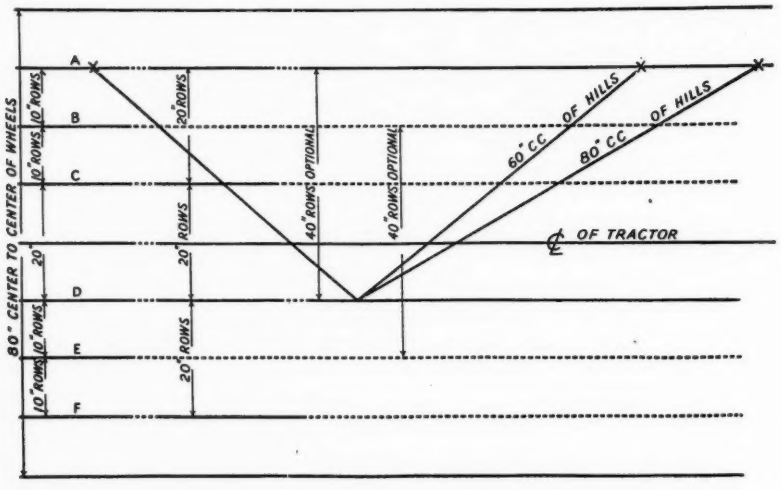
Connecting points on the tractor, for implements which can be attached and removed quickly and easily, are of great importance to the farmer, especially at the season of the year when part of the day the tractor should be operating a direct-connected mower and then changed quickly to cultivating, or some drawbar or belt work.

Corn and cotton planters, direct mounted, have advantages in short turning and better control by operators. Grain drills and potato planters seem most practical as trailing implements. Row-crop cultivators operate at higher speeds and more efficiently when direct mounted. Field cultivators, disk harrows, drags, etc., operate better as trailing machines.

Direct-connected plows are always desirable in small fields because of retaining the turning radius of the tractor; also in irrigated land with 2-way plows because of short turn to get back into the same furrow. Direct-connected middle breakers are desirable in preparing land for cotton where planting is done on beds.

Harvesting machines are generally trailing type, although mounted corn pickers are now considered more efficient due to better control by operator. Irrigated crops are responsible for special problems in plowing, planting, cultivating and harvesting. Truck crops on beds require special features on planters and cultivators.

A ten-acre truck farm may be plowed three times a year, a total plowing of thirty acres. A sixty-acre farm



SUGGESTED STANDARD ROW SPACING FOR TRUCK GARDEN CROPS

having average crops, with pasture and hay land, may not require over thirty acres of plowing.

A sixty-acre irrigated farm may have 15 to 25 acres of deep plowing for beets, which is difficult or impractical with animal power, and keeps the power requirement high compared to any other operations on the same farm.

Visualize a small general-purpose tractor with five types of plows; five types of planters; five types of cultivators; and five types of harvesting implements, operating on corn rows, cotton rows, potatoes, beans, beets, truck crops, with spacings from 10 to 60 in, on all varieties of soil, on level and hilly ground, with some rocks, stumps, and mud holes. In addition, many farmers on ten to one hundred acres have feed to grind, silos to fill, water to pump, wood to saw, and feed racks to fill. They need power to haul wagons, sleds, and trailers, and for operating a manure spreader and a snow plow.

TABLE 1. 1935 TOTAL OF FARMS IN THE UNITED STATES—6,812,350[1]

Under 3 Acres	35,573
3 — 9 "	535,258
10 — 19 "	683,452
20 — 29 "	557,979
30 — 49 "	882,164
50 — 69 "	581,352
70 — 99 "	862,655
100 — 139 "	754,076
140 — 174 "	650,221
175 — 179 "	33,720
180 — 219 "	294,309
220 — 259 "	212,238
260 — 379 "	338,478
380 — 499 "	134,761
500 — 699 "	106,377
700 — 999 "	61,075
1000 — 4999 "	77,825
5000 — 9999 "	6,208
10,000 acres and over	4,629

[1]U. S. Department of Commerce figures.

The division of farms as to size and number in Table 1 show that the greatest number are one-plow size, and that the next greatest would be classed as two-plow size.

Referring to Table 2, showing summary of implements, crops and spacings, note that over twenty implements are used in connection with the small general-purpose tractor on corn, cotton, potatoes, beets, beans, melons, grain sorghum and a large variety of truck crops, with row spacings of 10 to 60 in.

Fig. 1 shows a chart illustrating a suggestion for standardizing truck crop row widths.

The rear tractor wheels are set 80 in, center to center; six 10-in rows are located between the wheels, with 20 in allowed for wheels. Four 20-in rows are located between the wheels, with a quick change in cultivator tools. Two 40-in rows are located between the wheels, with option of two locations.

Spacings of 60 to 80 in between hills of melons, cucumbers, etc., can be located on 40-in rows by alternating hills as shown. All these varieties can be cultivated with tractor wheels remaining 80 in, center to center, with slight shifting of tools on the cultivator tool bars.

Rows marked A, B, C, D, E, and F can be planted on a bed or on a flat field.

Rows A, C, D, and F can be planted by leaving seed out of the other two planters, making four rows of 20-in spacing.

Planters can be used as markers to locate the line for hills of melons or cucumbers which are put in alternately to distance required between hills.

TABLE 2. VARIETIES OF OPERATIONS, CROPS, AND SPACINGS

PLOWING

1—bottom, direct connected for truck garden—beet, grain, corn and potato land
2—bottom, trailing for truck garden, beet, grain, corn, and potato land
1—bottom, middle breaker for cotton, corn, kaffir, and sorghum land
2—disk for cotton, corn, vetch, and sorghum land
4—disk for cotton, corn, vetch, and sorghum land

PLANTING

Corn—2-row — 36, 38, 40, 42, 44, and 46-in spacing
Cotton—2-row — 36, 38, 40, 42, 44, and 46-in spacing
Lister—2-row — 38, 40, and 42-in spacing
Potatoes—28, 30, 32, 34, 36, 38, 40, and 42-in spacing
Truck crops—10, 12, 14, 18, 20, 24, 28, 32, 36, 40, and 60-in spacing

CULTIVATING

2-row — corn — 36, 38, 40, 42, 44, and 46-in spacing
2-row — cotton — 36, 38, 40, 42, 44, and 46-in spacing
2-row — lister — 38, 40, and 42-in spacing
4-row—beets and beans — 20, 22, 24, 26, and 28-in spacing
2-row (truck crops — 28 to 60 in) (4-row — 20 to 28 in) (6-row 10-in alternating)

HARVESTING

Grain binder — horse drawn, power driven
Corn binder — horse drawn, power driven
Corn picker — trailing, direct connected
Hay tools — mowers, rakes, and sweep rakes
Potato diggers — horse drawn, power driven
Beet puller — direct connected

Requirements of the Small All-Purpose Tractor from the Implement Engineer's Viewpoint

By J. R. Orelind

IN THIS discussion no attempt is made to completely cover the requirements for the small tractor. I will merely mention some tractor features that I have found desirable in designing implements for general-purpose tractors.

In order to be economically successful on the smaller farms, the small tractor should be in the fullest and widest sense of the word an all-purpose tractor, so as to replace horses completely. It should have power enough to pull one 16-in plow bottom or one middlebuster under all but very adverse conditions. It should handle a two-row cultivator at a reasonable depth. It should not only do all other tillage and harvest work, but also hauling on the farm and on the highway. It should be of the tricycle type, as this type seems best suited for all-purpose work.

In addition the tractor should furnish power for stationary odd jobs, such as corn shelling, feed grinding, and water pumping. Instead of being driven by belt, some of these machines could perhaps advantageously be designed to be driven from the power take-off on the tractor by means of a telescoping shaft with universal joints. With such an arrangement the hook-up could be made very quickly, without lining up the tractor in exact position. A minute after the farmer came home from the field with the tractor, he could be, for instance, pumping water. This drive would not be affected by wind or rain.

One important requirement for a successful one-plow tractor is that its design should be suited for the mounting of direct-connected implements.

The most widely used direct-mounted tool is the two-row corn or cotton cultivator. To accommodate the cultivator, the tractor should have at least 24-in clearance under the front end of the body, clear to the front edge at the rear wheels, in order to make it possible to place cultivator shanks in this space. Otherwise, a center rear gang must be provided, which complicates design and increases cost. Rear gangs with several shovels extending far to the rear swing in the opposite direction to the way the tractor is steered and may, in extreme cases, cut out the rows. This is also true when the tractor slips sideways in cultivating hillsides. The ideal cultivator should have all the shovels in front of the rear wheels with the exception of two, one mounted very closely behind each rear wheel to cut out the tracks of flat steel rims and pneumatic tires.

The body of the tractor should be narrow to make it possible to set the cultivators for close row spacings. The sides of the tractor should be clean and free from projecting accessories, which interfere, not only with vision when cultivating, but also with design of numerous side-attached implements, such as seed cans and drives for planters. Great designing effort should be exerted to place accessories such as carburetors, governors, air-cleaners, etc., close in to the engine, and possibly make them flat instead of round and bulging. By this method a natural slender streamline would be obtained.

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Author: Experimental engineer, Minneapolis-Moline Power Implement Company. Mem. ASAE.

The flywheel housing should be made as small in diameter as possible, both in order to increase the ground clearance and to make that part of the body more narrow. From looking over sectional drawings of different general-purpose tractors, it appears that the diameter of the flywheel could be made smaller and the rim correspondingly wider. It is true that the flywheel would then have to be heavier to give the same flywheel effect, but the housing would be lighter and the smaller diameter of both flywheel and housing would cost less to machine. It would seem well worth investigation to determine how much smaller the diameter could be made, without materially increasing the cost.

The clearance under all parts behind the rear axle such as platforms, power lifts, etc., should be not less than 30 in, in order to provide room for direct-connected plows, listers, and middlebreakers with rolling colters and gage wheels. The drawbar which, of course, will have to be placed lower than 30 in, should be so designed that it could be quickly swung up out of the way or detached.

The tread of the rear wheels should be easily adjustable, so it can be narrowed down for plowing. On a three-plow, general-purpose tractor this is not necessary; on a two-plow it is desirable; but on a one-plow it is imperative in order to avoid excessive side draft.

To entirely eliminate sidedraft when using one 16-in plow, the tread would have to be narrowed down to about 38 in. With such a narrow tread there would be considerable danger of the tractor tipping over sidewise. A happy compromise would probably be to make the minimum tread about 48 in, center to center of wheels, and plow with some sidedraft.

The tread should be adjustable in fine steps, or preferably continuously, in order to fit the row spacing closely. This is important, especially in listed rows, in order to be able to stay on top of the ridges without too much danger of sliding off. With a continuous tread adjustment of from 48 to 80 in, the tractor can straddle two rows of any spacing from 24 to 40 in exactly, and 42 and 44-in rows close enough for practical operation under most conditions. It will also straddle four rows of beets with up to 20-in spacing.

To get such a wide range of tread, the wheels are generally built with offset hubs and reversed for extreme adjustment. Some wheels are furnished with unsymmetric lugs, or with a pneumatic tire tread, which drives only in one direction. When making the extreme tread adjustment with these wheels, it is necessary to interchange right and left wheels. This design should be avoided on the one-plow tractor, which has to be changed often for extreme tread adjustment, because it is both difficult and dangerous to have both right and left-hand rear wheels jacked up and removed at the same time.

While the one-plow tractor should be small and light, there are several good reasons why the wheelbase should not be made too short. One reason is that there is not room for placing a properly designed corn or cotton cultivator between front and rear tractor wheels, unless the longitudinal distance from the rear edge of the front

wheels to the foremost edge of the rear wheels is three feet or more.

Another reason is that the longer the wheelbase, the more side-draft the tractor can stand without side-skidding the front wheels. This is a valuable feature when using a one-bottom plow.

The all-purpose tractor works with two general types of load application. When pulling a load at the drawbar, there is an uplift at the front end, but when pushing a direct-mounted cultivator there is an added load on the front end, due not only to the weight of the cultivator frame, but also to the draft of the cultivator gangs in front of the rear wheels. The weight distribution between the front and the rear wheels can therefore never be made correct for both cases. However, the longer the wheelbase, the less the weight shifts from front to rear, and vice versa for the two different load applications. This is another reason for not making the wheelbase too short.

It is, however, not advocated to make the wheelbase extremely long, as that would add to the cost and require too much space in turning. It is merely pointed out that there are good reasons for not making the wheelbase as short as one may be led to believe would be proportionate for a tractor of this small power.

One way to get a more equable weight distribution is to design the front end of the tractor light enough to suit cultivating, and then add weight on the front end, or in the front wheels, for drawbar work. Instead of cast iron weights, which cost money, one could perhaps use a sheet steel weight box or pan to be filled with rocks or dirt, which is always readily available and cheap. A good place for this pan would be under the tractor behind the front wheels in the very high clearance space provided for the cultivator. When the cultivator is used, the weight is not needed and can be dumped and the pan detached.

The center of gravity should be kept as low as possible and yet maintain the 24-in clearance under the engine. This is more important on the one-plow tractor than on any other size, because it has to be used with such a narrow tread for plowing. It is therefore important to select an engine of small overall height. No detail should be overlooked for lowering the weight of the upper parts of the tractor, such as making the top tank of the radiator of sheet steel instead of cast iron.

The use of small diameter rear wheels is one of the most effective ways to reduce cost, reduce weight, and lower the center of gravity, all three of which factors are of the utmost importance in the one-plow tractor. On larger tractors, the wheels may have to be larger in order to carry the weight and to get enough traction, but on the one-plow size, it seems safe to say that the wheels should be of the smallest diameter it is possible to use with live axles and still get clearance enough for cultivating corn. To get sufficient clearance with small wheels, that portion of the axle housing which passes right over the corn row could be made eccentric with the shaft, moving it up until the lower wall barely clears the shaft.

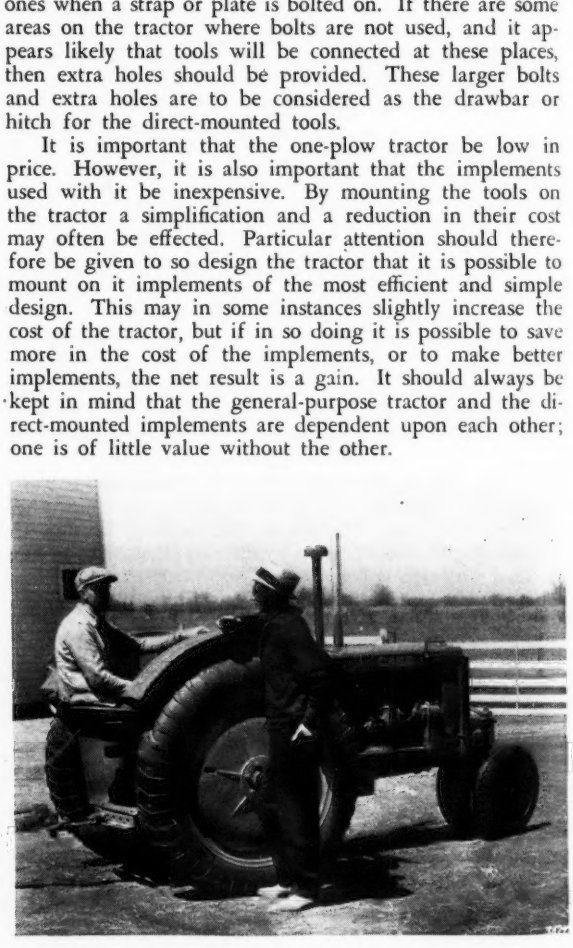
Smaller rear wheels leave more space for implements, both in front and rear. With large diameter wheels, some of the rear-mounted implements, such as planters, will be placed so far back that they are likely to up-end this light tractor.

The front wheels, or wheel, should be of ample size and strength to support the greatly increased load imposed when cultivating. This fact seems sometimes to have been overlooked in general-purpose tractor designing. A single front wheel is necessary for work in narrow rows; dual front wheels are required for work on lister ridges.

Implements should be arranged for quick-on or quick-off mounting. This can often be accomplished by bolting plates or clips to the tractor, and then attaching the tools to these clips by slip pins instead of bolts. The plates or clips are left on the tractor permanently. The flanges of housings and other parts should therefore be flat to accommodate the plates. The bolts should not be set in notches or depressions or too close to fillets.

The number and variety of implements that are mounted on the tractor is constantly growing. It is difficult for the implement designer to designate special attaching lugs or holes for any except the most common tools such as cultivators. But the tools have to be attached somehow. The tractor designer could greatly help the implement designer and thereby the industry, by keeping in mind that implement parts are likely to be attached to almost any part or bolt on the tractor from front to rear and from top to bottom. Most bolts should be of ample size to be used for attachments even though thereby they would be somewhat larger than needed for holding the tractor parts together. Capscrews especially should be large, really not less than $\frac{5}{8}$-in, so the threads in the castings would not be easily damaged by frequent use, or the heads sheared off leaving the threaded stem in the hole. Capscrews should be made about $\frac{1}{4}$ in longer than actually needed, so it would not be necessary to furnish new longer ones when a strap or plate is bolted on. If there are some areas on the tractor where bolts are not used, and it appears likely that tools will be connected at these places, then extra holes should be provided. These larger bolts and extra holes are to be considered as the drawbar or hitch for the direct-mounted tools.

It is important that the one-plow tractor be low in price. However, it is also important that the implements used with it be inexpensive. By mounting the tools on the tractor a simplification and a reduction in their cost may often be effected. Particular attention should therefore be given to so design the tractor that it is possible to mount on it implements of the most efficient and simple design. This may in some instances slightly increase the cost of the tractor, but if in so doing it is possible to save more in the cost of the implements, or to make better implements, the net result is a gain. It should always be kept in mind that the general-purpose tractor and the direct-mounted implements are dependent upon each other; one is of little value without the other.



THE GENERAL PURPOSE TRACTOR, AS A POWER UNIT, SHOULD PROVIDE FOR HITCHING OR MOUNTING TOOLS AT ALMOST ANY POINT

Requirements of the Small All-Purpose Tractor from the Implement Engineer's Viewpoint

By D. C. Heitshu

IN GENERAL, the requirements of the small type all-purpose tractor are identical with those of the better known two to three-plow size. Other than these general requirements there are three which are different and very important. These are (1) power, (2) general dimensions, and (3) cost.

Power. The minimum power permissible in the small all-purpose tractor is 8 to 10 drawbar horsepower, allowed rating. This, in other words, means a minimum rated pull of 1000 lb at normal field speed of second gear. Second gear usually provides a travel speed of 3 to 3.5 mph with steel wheel equipment.

This statement of power required for a small all-purpose tractor may appear to be nothing more than indorsement of the present tractors in this class. It is not that. It merely indicates that by various and sundry means of analysis the different designers found that the work to be performed by a small all-purpose tractor required a minimum pull of 1000 lb in second gear.

A tractor with less than 8 or 10 rated drawbar horsepower hardly can be considered an all-purpose tractor. Below this size a tractor is not "all-purpose" because it is too limited in its ability to perform the various farm operations. Such a tractor is a "few-purpose" machine, and it would be well to distinguish between the lighter motor cultivators or garden tractors, and the small all-purpose tractor.

The implement designer cannot build machines to do the work expected of a small all-purpose tractor unless, first of all, the tractor has the necessary power. The small tractor may serve as a supplementary power plant for a large tractor, but the largest market is the small farmer who will use one tractor for all of his work. This means that land preparation, along with the common belt work, must be within the range of performance of this tractor. When the variation in soil resistance is considered, along with topography, and other factors of lesser importance, it is seen why the implement designer insists on a minimum pull of 1000 lb at 3 mph.

It is a well-known fact that a farmer's profits are directly proportional to the number of horsepower-hours he uses. Profits are the most needed element in our agricultural situation. As engineers it is our problem to increase the farmer's profits (1) by substituting low-cost mechanical power for animal power, and (2) by increasing the farmer's efficiency by putting him in command of a larger power unit. If the unit we give him is smaller than 8 or 10 rated drawbar horsepower, we are only changing the farmer's source of power. A mere change from animal to mechanical power in most cases is not sufficient to warrant our interest, or the interest of the farmer. We must offer a substantial increase in possible profits.

Within the scope of this problem lies the need of selling the farmer a sufficiently large power unit for his farm enterprise. Naturally the tractor should have a desirable load factor. But enthusiasm for a high load factor must not overlook the factors of weather and timeliness of performance. Many farms of small acreage are not "small" farms. The size of the farm business, and the actual need for power must determine whether the farm is a small or large-tractor farm. With the present wave of popularity of the small all-purpose tractor, many of these machines have been oversold or overbought. When this is done it must be corrected, within a few years, at a loss to the farmer. Such transactions do not strengthen our position as agricultural engineers, nor that of the industry we represent.

General Dimensions. In endeavoring to make the small all-purpose tractor light in weight, compact in size, and simple in design, the minimum basic dimensions for crop clearance and implement mounting must not be overlooked. Crop clearance dimensions are well established by field experience.

The space required for implements, their method of mounting, etc., vary greatly. It seems that no two designers agree as to how a tractor-mounted implement should be made. However, all agree that satisfactory quick attaching and detaching mounts must be provided. Likewise the implement designers will agree that too often the tractor engineers give them too little clearance where it is wanted, and an abundance at points where it cannot be used. When it is necessary to "jack-knife" a cultivator gang, or indulge in some similar complication to make a satisfactory tractor-mounted implement, it is obvious that the minimum dimensions have been pared to the detriment of all concerned.

The dimensions of the small all-purpose tractor must provide for sufficient crop clearance, and the mounting of simple, sturdy, long-lived implements. An implement made compact at the expense of simplicity will never prove successful in the field.

Cost. The problem of cost, and the resulting selling price, of the small all-purpose tractor is of much importance to the designer and the farmer. Quite simply the question is that of getting the cost low enough for the farmer to buy the unit at a price he can afford to pay and still leave the maker a reasonable margin. While the problem is easily stated, it is far from easy to answer.

The facts in the case are that it costs almost as much for the labor to design, manufacture, sell, and deliver a small tractor, as for that involved in producing a large tractor. And labor is the largest single cost factor. This means the designer is hard pressed to save enough material and labor for the selling price to be satisfactory to the farmer buyer. Added to this is the fact that the two to three-plow, all-purpose tractor best meets the needs of the majority of farms, and therefore sells in the greatest volume. This prevents the tractor builder from using the formula followed by the automobile manufacturer in the low-priced car field, namely, a minimum margin with maximum sales. However, minimum margin is something the implement industry is well acquainted with, regardless of sales.

Since the unit cost is not a straight-line function, the

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small farmer has to pay a premium for the horsepower he purchases in the form of a small tractor. This premium is between $15 and $20 list per drawbar horsepower. The list price per drawbar horsepower ranges from close to $50 in larger all-purpose tractors to over $70 in the smaller sizes.

Little can be done about this differential in cost of the large and small tractors, but, by careful implement design, the overall cost of the small all-purpose tractor and its implements can be kept within suitable limits. One means toward this end is to use hand-lift tools instead of the power lift so very common with the heavier implements on the larger tractors.

Lighter and simpler tools lend themselves to satisfactory use with the small tractor. Let us recall an old and well-known formula, $KE = \frac{1}{2}MV^2$. Here is the agent of destruction among tractor implements. However the small tractor attacks this blackguard from both ends. The factor M (mass) is reduced approximately one-third, and under many conditions V (velocity or speed) is reduced. Considering these facts, a saving can be made in the implements for the small tractor, provided, of course, that good engineering judgment is exercised in the design.

As more is being learned of the exact forces acting on implements, a saving can be made by putting strength where strength is needed. The generous adding of metal here, there, and in between because "it looks light" is not good design for small tractor implements. These implements should be no heavier than necessary to make them satisfactory and durable machines for the user. But at no time can durability be slighted. The implement must be capable of doing the job without failure, for here lies the difference between profit or loss for the farmer.

Hose Coupling for High-Pressure Spray Lines

By E. M. Dieffenbach

THE swivel in the coupling of a high-pressure spray hose such as used for orchard spraying has several disadvantages, although it is a practical necessity for long hose lines. However, when spraying from the top of the machine, as is now popular with high-pressure portable sprayers, the spray hose is short and a swivel coupling is not needed. By eliminating the swivel from the female member, a coupling can be made that is lighter, less bulky, stronger, of larger capacity, and lower in cost. The female member of ordinary hose coupling is especially difficult to construct for use with ¾-in hose to attach to ¾-in hose thread, and this size hose is needed with the large spray guns to keep down pressure losses. This article describes a coupling without swivel for this size hose, one which can be easily made wherever a lathe is available. This coupling was designed and constructed during investigations of orchard spraying by the U. S. Bureau of Agricultural Engineering.

The demonstration model was made from cold-rolled brass, and was tested in hose with a hydrostatic pressure of 1000 lb per sq in without rupture. The demonstration model was further tested with a season's spraying, alternating on several sprayers. For still greater strength and wear resistance, the coupling could have been made of stainless steel.

Fig. 1 shows the two members of the coupling, with dimensions for fitting ¾-in hose. The weight is 7.3 oz for the female member and 6.7 oz for the male member. In finishing the members, no sharp corners should be left on the outside to cut the hose, and the inside of the coupling should be finished smooth to allow easy passage of liquid.

When installing the parts in the hose, the female member should be inserted first as it can be more readily held in the vise. The outside of the member to be installed and the inside of the end of the hose are liberally coated with rubber cement for a lubricant, and the hose is pushed on immediately. A strong push and a slightly twisting motion is required. With a hose washer in place, the other member of the coupling is screwed into the female member, and the other end of the hose is attached in a similar manner. Fig. 2 shows the two members of the coupling after installation. Note that no provision is made for use of a wrench with this coupling. It is not necessary to use a wrench to connect hose of this size if properly washered.

For wrapping the hose, soft brass wire of about No. 14 (American Wire Gage) is suitable. The wire is most readily used when wound on a short round stick in the form of a spool, as shown in Fig. 3. The wrapping tool is a small piece of board with two holes slightly larger than the wire. The free end of the wire is caught under the wrap, to be available for the tie. A few wraps behind each barb of coupling member are sufficient.

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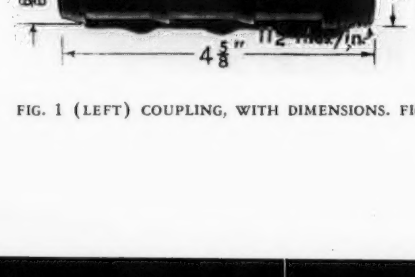
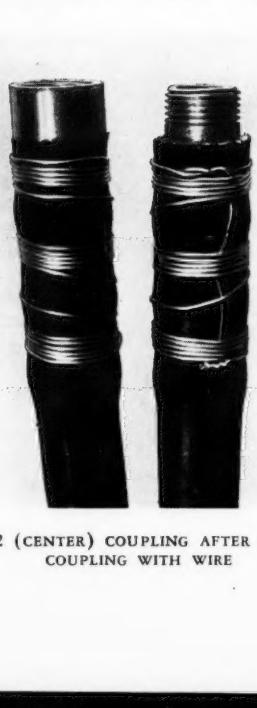
Author: Assistant mechanical engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. Mem. ASAE.





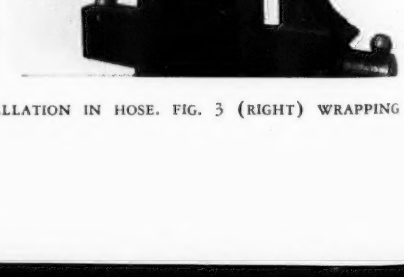


FIG. 1 (LEFT) COUPLING, WITH DIMENSIONS. FIG. 2 (CENTER) COUPLING AFTER INSTALLATION IN HOSE. FIG. 3 (RIGHT) WRAPPING COUPLING WITH WIRE

Power Development on Federal Reclamation Projects

By Geo. O. Sanford

IN THE course of constructing its very earliest irrigation projects, the U. S. Bureau of Reclamation built its first power plants. They were small and were designed to provide power during the construction period, thus to reduce costs. Later, power developments were undertaken to provide energy for pumps used in irrigation and drainage. In more recent years the development of power has in some instances been inseparable from irrigation. This has resulted from the fact that projects progressively have become more and more complex. Power revenues were needed to reduce the charges against the land and to make the projects economically feasible.

So far, 23 hydroelectric plants, with an installed operating capacity of 134,337 kva (kilovolt-amperes) have been constructed at a cost of approximately $9,328,000 on 12 of the 39 operating projects of the Bureau. The total hydroelectric power production on federal reclamation projects for the fiscal year ending June 30, 1936, was 507,761,378 kwh. The gross power sales amounted to approximately $3,315,000.

These figures do not include the Boulder Canyon project, which began operation in September 1936. Power produced by plants on federal reclamation projects up to the date when the Boulder Dam plant went into operation, was relatively small. With the completion of Boulder Dam, which now is producing about 80,000,000 kwh per month, and with the development of the Central Valley project in California, the Columbia Basin project (Grand Coulee) in Washington, and the Casper-Alcova project in Wyoming, federal reclamation hydroelectric operations promise to become an important factor in the field of power generation.

The first installation was made on the Salt River project in Arizona. In the construction of the Roosevelt Dam, the engineers were confronted with the problem of obtaining cheap power. It was solved by the construction of a low diversion weir and power canal leading to the dam site. Work was started in 1903, and a 1,300 hp plant was operating in the spring of 1906. This plant not only furnished power for the construction of the dam, but also for the operation of a cement mill which manufactured 338,452 barrels of cement, with a saving of approximately $600,000.

Similar situations arose in connection with the construction of the Strawberry Tunnel of the Strawberry Valley project in Utah, in construction of the Arrowrock dam of the Boise project in Idaho, and in other work. They were met in each case by the installation of a small power plant. These plants were figured in as a part of the construction cost of the project involved and are being repaid by the water users.

Plants to provide energy for pumping for irrigation and drainage were designed as a part of the waterworks. Examples are the 10,000-kva Black Canyon power plant on the Boise project, completed in December 1925, used primarily for pumping irrigating water on the Owyhee project, and the Siphon Drop plant on the Yuma project in Arizona, which develops about 1,000 kw under a 10-ft head and furnishes power for pumping at a cost of only 0.8 cent per kwh, as compared with 2.8 cents per kwh formerly paid for purchased power.

Whether power plants were installed for construction or for pumping purposes, opportunities arose for the sale of power for commercial uses. Concurrent problems developed with respect to rates to be charged and the allocation of costs and revenues.

Before going into these matters in detail, the third and highly important type of irrigation and power project should be recognized. It is epitomized by Boulder Dam, and is the type of project in which power generation is deliberately included as a major consideration, and in which the sale of power is expected to repay or to contribute largely to the repayment of the cost of construction. While projects in this class are dependent upon power generation and sale for their existence, since otherwise they could not be financed, they are not "power projects." They are something more. In each case, power remains the byproduct of the primary conservation objectives, water supply, flood control, and river regulation.

Boulder Dam of the Boulder Canyon project, Kennett Dam of the Central Valley project in California, Grand Coulee Dam of the Columbia Basin project in Washington, and Seminoe Dam of the Casper-Alcova project in Wyoming, four members of this third group, can best be described as multiple-purpose dams. Each is the keystone of a comprehensive program for use of a major water resource.

"Combination of irrigation and power obviously brings about a double use of water and thus increases the value and overall efficiency of that water," John W. Haw and F. E. Schmitt, serving as an independent commission to investigate the efficacy of the federal reclamation policy, reported to Secretary of the Interior Harold L. Ickes. "Full development of power possibilities is therefore desirable in the public interest."

Despite general acceptance of this principle in recent years, there has been no precise and general answer to the question: Who is entitled to the profits of these power plants, once their cost has been repaid?

Congress has spoken several times in this regard. In 1924 it passed a bill which provided that when a project is turned over to the water users for operation and maintenance, the net revenues should be credited annually; first, on account of project construction charge; second, on account of project operation and maintenance charge; and, third, as directed by the water users.

Later special legislation directed that the net power revenues on certain projects be applied; first, to repayment of the cost of the power system; second, to the repayment of part or all of the cost of special irrigation features; and third, to the reclamation fund.

In the Boulder Canyon Project Act of 1928, Congress required sale of power to repay the cost of Boulder Dam

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Excerpts from a paper presented before the Institute of Irrigation Agriculture, at Corvallis, Oregon, April 1, 1937.

Author: General supervisor of operation and maintenance, Bureau of Reclamation, U. S. Department of the Interior. Mem. ASAE.

and power plant with interest at 4 per cent in fifty years. No interest is involved on projects constructed under the reclamation law.

The project water users have a direct and double interest in the power rates. In many instances they are the consumer of the energy, and therefore have to pay the charges. They are also benefited by the net revenues earned, because these reduce the construction costs which must be assessed against the land.

It is not entirely a case of taking money out of one pocket and putting it into another since a considerable portion of the power is sold to project cities and towns. On the Minidoka project, the largest part of commercial power is sold to the cities of Burley and Rupert, which pay around $12,000 a year.

It is necessary to maintain wholesale rates on a fair and equitable basis. High rates bring protests from the cities. Low rates bring objections from water users.

Revenues received from the sale of surplus power are a most effective method of collecting payment for the indirect benefits which cities and towns derive from irrigation development. This question of payment for indirect benefits has received considerable attention. Where the city has come into existence after irrigation districts have been created and repayment contracts executed, often there is no way but through the sale of power to assess any of the construction cost against the city property.

The primary work of the Bureau of Reclamation is and always will be the development of irrigation water supplies and the creation of new homes and communities in the arid West. But our projects are growing increasingly complex. The storage dam of the future, like Boulder Dam, will control entire rivers, and it must be made to serve all conservation purposes, prominent among which will be flood control, river regulation for irrigation and domestic uses, improvement of navigation and power generation.

In planning new projects, we must deal not only with present needs, but also with the economic problems of the future. Present developments must not conflict with future needs. Undertakings of the Bureau of Reclamation, therefore, must be based not only on adequate engineering plans and designs, but in addition on searching economic reports and investigations.

Where it is possible to develop power in connection with irrigation improvements, power must be considered. With water as scarce as it is in the West, it is important that what water we have does double duty.

Water Vapor for Agricultural Spraying

By R. M. Merrill

DURING the past two seasons the Bureau of Agricultural Engineering of the U. S. Department of Agriculture has carried on preliminary field tests using water vapor as a carrier for applying a number of insecticides and fungicides. These tests were made in cooperation with the Bureau of Entomology and Plant Quarantine and with the Ohio Agricultural Experiment Station.

The vapor generator used for the tests was a commercial machine designed primarily for cleaning purposes. The generator unit is a flash boiler using a pressure atomizing fuel oil burner for heat. The fuel pump, blower and water pump are operated by a one-horsepower gasoline engine. The capacity of the unit used was 1.2 gal of water per minute. A few alterations were made in the commercial generator unit to adapt it for the experimental spraying tests. In order to avoid the possibility of any damage to the heater coils by the chemicals used for spraying, and to minimize the effect of heating these chemicals, an auxiliary solution tank with agitator was arranged with a separate pump for forcing the spray solution into the vapor delivery line. With the pumping arrangement used, this meant 0.8 gal of water per minute through the coils and 0.4 gal per minute of concentrated spray material forced into the heated water outside the coils, making a total delivery of 1.2 gal per minute.

Experimental spraying during the past season has consisted mostly of applying the regularly accepted chemicals now being used rather than trying new types of materials. Some of the materials applied were acid tar oil, phenothiozene, free nicotine (50 per cent), lime sulphur (liquid and dry), lead arsenate and lime, nicotine sulphate, wettable sulphur, calcium arsenate and lime, nicotine bentonite, bordeaux mixture, derris, and copper oxychloride.

The crops sprayed during the season were peas, for pea aphid; apples, for scab and codling moth; cherries, for leaf spot; grapes, for berry moth and root worm; potatoes, for insects and disease; tomatoes and cucumbers, for insects and disease; and raspberries, for anthracnose.

It is not thought that the seasons results are in any way conclusive, but they indicate the possibility of using water vapor for applying almost any type of material. From observations and from actual counts it seems that effective application of material was made on apple and cherry trees with about one-third to one-fourth of the material ordinarily used with the conventional sprayer. The effectiveness of the sprays in general apparently was about the same as those applied with the conventional sprayer.

Presented before the Power and Machinery Division of the American Society of Agricultural Engineers at Chicago, December 2, 1936.

Author: Agricultural engineer, Bureau of Agricultural Engineering U. S. Department of Agriculture. Mem. ASAE.

Upstream and Downstream Attack on Flood Problem

IN coordinating upstream land treatment work with flood defenses at downstream danger points, the United States has now launched the most complete attack on the flood problem ever undertaken in this country, H. H. Bennett, chief of the USDA Soil Conservation Service, told the National Rivers and Harbors Congress, in a recent address.

The Omnibus Flood Control Act of 1936, he pointed out, gives full legislative recognition to the necessity for including in flood control plans, the prevention of floods at their point of origin in upstream watersheds. Under provisions of this Act, he said, the Department of Agriculture is preparing to survey land-use conditions in more than 200 watersheds as a basis for developing upstream flood control programs to be recommended to Congress. Actual prosecution of such programs as a supplement to downstream engineering work is contingent on Congressional action, Bennett explained.

C. O. Reed Wins McCormick Medal Award

ONCE more the annual award of the Cyrus Hall McCormick Gold Medal recognized not the event of a year but the achievement of a life. The recipient for 1937 is C. O. Reed, professor of agricultural engineering at Ohio State University, and formal presentation of the medal will be made at the annual meeting of the American Society of Agricultural Engineers next month. Fittingly this will occur at the University of Illinois where, twenty-six years earlier, he won his bachelor of science degree after working his own way through his entire course.

C. O. REED

Both the award and Mr. Reed's career may be a mystery to minds of mercenary motivation, for early in his professional life he demonstrated his caliber in big business, then deliberately declined proffers of further advancement and returned to the college campus. From his graduation in 1911 until 1917 he remained at Illinois as instructor in field machinery and extension specialist, with such success as still calls forth comment among Illinois students of that period. Meanwhile there developed within him a determination to challenge the saying that "men teach because they cannot do anything else."

So in 1917 he became agricultural representative of George Batten, Inc., then the second largest advertising agency in America, for whom he secured accounts, counselled their handling, and aided investigations of products, markets, manufacturing facilities, and policies. In 1919 he joined the Samson Tractor Company as advertising manager. The following year he became head of the company's bureau of investigation and research and member of its executive council; also was in charge of instruction in the Durant School. During 1920-21, while he was a division sales manager for Samson, he held in abeyance his underlying love for agricultural engineering education and declined an offer to head the department in a large midwest university because its organization fell short of his ideals for the proper development of agricultural engineering. How well he dealt with a difficult job, and how highly he impressed his associates among the executives of the General Motors Corporation, is attested by the fact that, four years later, they sought him to become personnel director of the corporation's export division.

Meanwhile, in 1922, he had joined Ohio State University as an instructor in agricultural engineering, reaching the rank of professor the following year, and in 1926 becoming also associate in agricultural engineering in the allied experiment station. Despite his demonstrated capacity as an administrator, he focused the full force of his personality on the problems of teaching and research, declining to pursue promising consideration for headship of the department in another university and the presidency of an eastern agricultural school—both prospects which appeared during his first year at Ohio.

Nevertheless, his administrative resources were not to go untapped. With the coming of the corn-borer crisis he was drafted by the federal government as a co organizer of the famous ten-million-dollar clean-up campaign in 1926, and the following year was in charge of its engineering aspects. Though this writer is not privy to the deliberations of the jury of awards for the McCormick Medal, it seems certain that Professor Reed's masterful handling of that desperate situation must have loomed large in their minds. Few but his able associates in that battle against the European invader know how much America owes to his energy, judgment, and leadership in stemming the tide until biological balance and adjustment of farm practice brought the corn-borer under control. For four further years he acted as consultant to the U. S. Bureau of Entomology and Plant Quarantine, and continues with that bureau as a collaborator in Dutch elm disease eradication.

Other activities along the way include teaching of farm machinery at the National Summer School, Logan, Utah, in 1924 and 1934; chairmanship of the agricultural engineering section of the National Institute of Rural Affairs at Blacksburg, Virginia, in 1929; and continuing activity—earlier as head of the ASAE subcommittee and now as general chairman—in the National Joint Committee on Fertilizer Application. He is the originator of the Ohio multiple-plane method for accurate recording of relative placement of seed and fertilizer, an expedient that has greatly facilitated the extensive studies of this relationship and has resulted in commercial production of depositors which add materially to the safety and efficiency of fertilizer usage, notably with corn.

Yet all of this is incidental to his first and last love—agricultural engineering education. In this immense realm it is impossible to pick out dates and items to define his contribution and achievement as it would be impossible to drive stakes in a mighty river. To be sure, he has been active in the teaching methods group of his college, and a leader in the use of objective quizzes. His colleagues credit him with putting to work some of the tougher phases of educational psychology. But somehow he stands not as a mere pedagogue of engineering, but as a creator of engineers; not a patient peddler of tedious technology, but the fiery light of vision and enthusiasm which illumines destiny and inspires leadership. On one occasion upper classmen were asked each to name the three most interesting professors in the college of agriculture. Professor Reed was the only one to make a majority among the widely scattered votes, his name being mentioned by 31 of 42 students.

Chester Otis Reed was born on a farm at Gates, New York, July 26, 1885, and lived on the farm until his twentieth year. Beginning in the rural school, his education continued in the grade and high schools of Rochester, with graduation from the Pittsford high school following re-

moval of the family home to that point. Among the work which sustained him during his course at Illinois was vacation employment by the International Harvester Company as field expert. While an undergraduate he was admitted to the honorary fraternity Alpha Zeta and the professional fraternity Alpha Gamma Rho; on graduation he joined Gamma Alpha. He also belongs to the scientific and honor societies Sigma Xi and Gamma Sigma Delta.

The annual award of the Cyrus Hall McCormick Medal was established by three members of the McCormick family—Mr. Cyrus H. McCormick, Mrs. Emmons Blaine, and Mr. Harold F. McCormick—as a memorial to their father, the inventor of the reaper, and to foster further advance in the realm of engineering to which the reaper was an epochal contribution. Not primarily a writer, Mr. Reed has been author or co-author of some 75 technical or semi-technical articles, a number of official bulletins, and sundry textbooks, contributions to the Encyclopedia Brittanica, etc. It now seems strangely pertinent that one, "Common Binder-Head and Knotter-Head Troubles and Remedies," has been translated into three languages and used almost verbatim as instructions by some of the large harvester companies.

While administration of the McCormick Medal and of its sustaining endowment has been entrusted to the American Society of Agricultural Engineers, membership and activity in the Society, as such, are not considered by the juries in choosing recipients of the gold medal, which is conferred simply for "exceptional and meritorious engineering achievement in agriculture." Yet the Society finds honor in the fact that Mr. Reed began attending its meetings in 1908, the year after its formal organization, and the next year, while he was still an undergraduate, became a member.

For about a year in 1911-12 he was the Society secretary. And though the record is incomplete, some years being entirely lacking, it does show that in sixteen of the intervening years he has been a member or chairman of one or several committees, and for a term of three years he served on the Society's executive council.

Almost a charter member of the Society, a consistent co-worker therein, one of the earliest to conceive the true scope of agricultural engineering as a profession, a tireless educator who has given the touch of genius to its teaching, a research worker of high repute, a leader and organizer in time of public peril, a personality whose friendship is everywhere prized, C. O. Reed deserves in full measure the congratulations which his colleagues will heap upon him as the 1937 Cyrus Hall McCormick medalist.

What Agricultural Engineers Are Doing

FROM THE USDA BUREAU OF AGRICULTURAL ENGINEERING

ONE of the developments of the Maine Potato Storage Investigation which A. D. Edgar of the Division of Structures is now completing is a better understanding of the use of condensation in the control of storage conditions. In the past storage conditions have been improved by heating and ventilating sufficiently to control storage temperature and avoid condensation of moisture. Too much ceiling condensation caused dripping and rotting of potatoes, and condensation also caused decay of unprotected structural members. Mr. Edgar found that condensation has been an unrecognized factor in control of conditions and that high humidity consistent with low shrinkage loss could not be maintained in poorly insulated structures. Further it was found that moisture could be removed by condensation with far less heat loss and with less attention of the operator than when removed by ventilation. Under the Bureau's new control method higher storage humidity is maintained and potato losses are lower as a result of allowing condensation on waterproofed surfaces, and ventilating only sufficiently to control temperature. The balance between wall and ceiling insulation and circulation retard ceiling condensation and the waterproofed surfaces were not injured by moisture. Thus condensation, once avoided, is now used, to save potatoes, heat and the operator's time.

* * *

The matter of balance between the cost of an installation and the cost of operating is emphasized by F. E. Staebner of the Division of Drainage as a result of observations in his studies of supplemental irrigation. Since low investment cost and high operating cost generally go together he says, high investment cost if properly planned usually should lead to low operating cost. There is a certain justification in the case of supplemental irrigation plants in working for the lower operating costs of two comparative designs that would represent substantially the same cost at the end of a specified number of years. That justification, he says, is due to the fact that with lower operating cost the farmer does not hesitate to irrigate upon reasonable indication that the crops are drying out. On the other hand, if the operating cost is high there is a marked tendency to delay irrigation upon the least sign of rain such as a few clouds or a little thunder. This often means holding off too long and failing to get the benefit of the outfit. There is a great tendency, says Staebner to save money by reducing the size of the pipe line without regard to the extreme importance of the friction factor and, therefore, a higher cost in operation results.

* * *

The development of the farm tractor is the subject of an historical study now being carried on by R. B. Gray and his associates in the Division of Mechanical Equipment. He is getting help from interested persons throughout the country who are sending in information regarding early tractors of all kinds and their use, including old catalogs, early advertisements and articles from technical and trade journals and farm papers. Dusty shelves, unused drawers and old files may contain material these men want for their history. Those who have such material are requested to send it in to Mr. Gray or write him about it. The address is Bureau of Agricultural Engineering, Washington, D. C.

* * *

February work of the 36 drainage camps of the Central District as reported by J. G. Sutton: Excavation, 400,324 yards, requiring 7,903 man-days; clearing 6,979,443 square yards, requiring 63,194 man-days; 11,960 linear feet of tile relaid, requiring 1,830 man-days, 11,870 man-days spent on other work, including structural and survey, 84,797 man-days spent on projects.

Mr. Sutton says there was comparatively little time lost during the month, adding that this is the second winter during which the drainage camps have operated with little loss of time. The chief difference in the work in winter as compared with other seasons is that most of the men employed on excavation are transferred to clearing work. Much less tile was relaid than in summer months.

* * *

Wells A. Hutchins spent the last part of February and early March at Bismarck, N. Dak., assisting State officials in drafting a water conservation law for North Dakota. The principles of the Montana water conservation law were followed in general, but were altered sufficiently to conform to North Dakota requirements and to give the administrative board broader

Contributions Invited

All public-service agencies (federal and state), dealing with agricultural engineering research and extension, are invited to contribute information on new development in the field for publication under the above heading. It is desired that this feature shall give, from month to month, a concise yet complete picture of what agricultural engineers in the various public institutions are doing to advance this branch of applied science.—EDITOR.

powers over the development and utilization of water. The bill is reported to have passed the Legislature with the emergency clause permitting it to be put into effect immediately.

* * *

In connection with tests of basin irrigation as a protection against frost damage, Karl Harris reports from Phoenix, Arizona, that two grapefruit groves that were not irrigated during the cold weather lost an average of 45 c.c. per fruit between January 1 and January 27, and from January 27 to March 1 made an average gain of 88 c.c. per fruit. A grapefruit grove that was irrigated almost continuously during the cold weather lost only an average of 14 c.c. per fruit from January 1 to January 27 and has made a gain of 60 c.c. from January 27 to March 1.

* * *

From the sugar beet project at Davis, Calif., S. W. McBirney reports that two sets of plots have been put in with the new chain-feed sugar beet planting unit designed to obtain uniform seed distribution. One set planted at the rate of one seed ball per inch, or 14 to 15 pounds per acre, is to compare time required for thinning and yields on plots planted with the new planter and check plots. The other at seeding rates varying from 10 to 20 pounds per acre is to compare germination stands with those on check plots and to determine comparative thinning rates.

* * *

I. F. Reed reports from Auburn, Ala., that the 1936 results of the legume coverage studies carried on in connection with the cotton production project show that the different methods of plowing under vetch caused the yield of seed cotton to vary from 1239 to 1497 pounds per acre. The gross variation in per acre value of the cotton produced, considering both quality and quantity was $20.43. Plots are now being prepared for the 1937 study. The outline has been extended slightly to cover other promising methods and conditions.

* * *

R. A. Work reports that at the Medford Branch of the Oregon Experiment Station during the coming season the study of the relation of irrigation to pruning of pear trees will be continued, using wider extremes in both moisture conditions and pruning. The studies of early versus late disking in of winter crop will be a continued, as will the orchard soil moisture control studies.

* * *

Charles E. Gapen, former chief of the press service of the department, has been appointed chief of the editorial and information division to succeed R. D. Marsden who has been assigned to special duties in the office of the chief of Bureau. Mr. Gapen took up his work in the bureau March 16.

* * *

Myron G. Cropsey of Hayward, Calif., has been appointed Junior Agricultural Engineer and assigned to duty with the farm structures information and exchange work of the Division of Structures.

* * *

Six one-room experimental houses are to be erected at Athens, Georgia, in cooperation with the University of Georgia to facilitate the study of comfort and convenience in farm houses. J. R. Dodge assisted J. W. Simons in planning the layout. Each house will be of a different material which might be suitable for use in farmhouse or tenant house construction.

The first will be a frame building of a type common in the South and will be used as a basis for comparison with the houses of other materials. The second will be of wood frame covered inside and out with galvanized sheet steel and with the stud spaces filled with treated cottonseed hulls for insulation. This house will have concrete piers and precast concrete sills and should be relatively fire-resistant and durable. The cottonseed hulls should provide sufficient insulation to make the house comfortable. The third house will be of wood frame construction with stucco on metal lath for the exterior and the back plastered on similar lath for the inside walls. This house will rest on a concrete slab in place of piers. The fourth house will be of precast concrete panels made from a light weight aggregate. These panels have been designed to use a minimum of material and should prove easy to cast and erect. As one of the objections to concrete for home construction has been the cost of the forms, it was felt that precast units or panels might solve the problem as one or two forms could be built and used over and over again. The fifth house will be covered with metal but will be slightly different in design from the insulated galvanized sheet steel house. The sixth house will be of steel frame construction with brick veneer or stucco finish.

* * *

A comprehensive bibliography on land drainage, compiled by Dorothy W. Graf, bureau librarian, has just been issued. The compilation lists nearly 3,000 articles, bulletins, pamphlets, and books.

* * *

An analysis of the work of the six CCC drainage camps for Missouri shows a commercial value of the work completed during the period from July 1, 1935 to December 31, 1936, of $1,508,700. The cooperation furnished by the counties and local drainage organizations totaled $431,200. The difference of $1,077,500 is a direct saving in drainage taxes to the counties and drainage districts. In this period the six camps maintained 378 miles of ditches and levees that required 9,500,000 cubic yards of excavation, and cleared of trees and brush 558 miles of ditches and 154 miles of levees.

* * *

Up to December 31, 1936, the five drainage camps in Iowa had done work worth $1,056,000. Of this $248,000 was furnished by counties and local drainage organizations. The saving to the counties and drainage districts is the difference or $800,000, a gain brought about by 199,700 man-days of work. This shows an average value of work done by men enrolled in the camps of a little more than $4.00 per man-day.

* * *

The central district drainage camps in March resumed dragline operations on many excavation projects on which activity was suspended during the winter. As a result, a total yardage of 1,198,312 is reported for the month, an amount approximately one quarter million yards greater than reported for the same month a year ago. Other production figures reported for the camps, in addition to excavation, are as follows: 9.120,513 square yards of clearing, 20,810 lineal feet of tile reconditioning, and 11,122 man-days used on structural and miscellaneous work. A total of 99,305 man-days were used during the month. Local cooperation furnished during this period amounted to $78,000.

* * *

M. R. Lewis spent the greater part of March in the Dakotas on water conservation work. The last legislature in North Dakota created a state water conservation commission with broad authority to investigate and construct all sorts of water conservation projects and appropriated $112,500 for its work. One of the earliest statements by the commission was that for the present its policy will be to exert every effort toward the utilization of waters now available. Another policy is to assist individual farmers and small cooperative groups in the irrigation of their own lands, with special emphasis on projects which can be completed this season. Mr. Lewis worked closely with the commission on these matters. In South Dakota the state planning board, under a grant from the National Resources Committee, is planning a preliminary study of water conservation projects with special reference to small irrigation schemes and stock-water dams.

* * *

To work up a basis for cooperative studies on the duty of water on lands in the vicinity of Ord, Nebraska, Leslie Bowen, in company with Carl Rohwer, made a trip to that locality and conferred with representatives of the Nebraska Experiment Station. The droughts of recent years have accentuated the need for irrigation, and in order to supplement the rainfall (averaging 24 in per annum), irrigation by means of gravity ditches is planned, and construction of canals is already under way. Water will be taken from the North Loup River. It is expected that 35,000 to 40,000 acres of fertile and reasonably level land will be irrigated.

* * *

R. L. Parshall reports that the Parshall measuring flume is now used extensively in the Arkansas Valley and in the South Platte Valley from Denver to Julesburg. Two canal companies serving more than 35,000 acres are planning to equip their entire systems with this flume. As evidence of the adaptability of the Parshall flume to conditions in Peru, Senor Enrique Gongora Pareja, of Lima, writes that while in charge of maintenance of the Imperial Irrigation Project (20,000 acres near Caneta, Peru), he installed more than 800 of them and that they have greatly facilitated the equitable distribution of water.

* * *

In connection with the project on storage of water underground, Dean C. Muckel reports that the Los Angeles County Flood Control District made an interesting test on its spreading grounds on San Antonio Creek cone, near Upland, Calif. Dynamite was used in holes punched 3 to 4 feet deep and about 5 feet apart to loosen the bed of the stream channel. The district's measurements showed that the percolation rate was increased from 3 to 18 acre-feet per acre per day.

* * *

The possibility of mechanically thinning beets, thus lowering the highest peak labor load in sugar beet raising, has been studied by E. M. Mervine and S. W. McBirney for three years and is now drawing attention from beet growers. Mechanical thinning is an extension of mechanical blocking, which has been adopted quite generally, and now the industry is encouraging more field trials of this experimental process.

PROGRAM

Annual Meeting of the American Society of Agricultural Engineers

University of Illinois, Urbana, Illinois - June 21 to 24, 1937

SUNDAY, JUNE 20

1:00 to 8:00 p.m.—Registration, East Parlor, Women's Building, University of Illinois Campus

2:00 to 5:00 p.m.—Council Meeting, Urbana - Lincoln Hotel

7:30 p.m.—Illustrated Lecture ("The Lincoln Country") *Dean Rexford Newcomb*, University of Illinois (Little Theater, Lincoln Hall)

MONDAY, JUNE 21

8:30 a.m. to 12:30 p.m.—GROUP SESSIONS

I — COLLEGE DIVISION

(Little Theater, Lincoln Hall)

Presiding: *Hobart Beresford*, division chairman

1 EXTENSION—Discussion led by *B. B. Robb*
- Extension Work and Agricultural Engineering—*J. C. Wooley*
- Extension Methods—*J. P. Fairbank*
- Educating Employees of Agricultural Engineers—*Dan Scoates*
- Vocational Program—*F. W. Peikert*
- 4-H Club Program—*F. E. Price*
- Publications—*M. R. Kulp*
- Bureau of Agricultural Engineering, USDA—*S. P. Lyle*

2 EDUCATION—Discussion led by *C. O. Reed*
- Agricultural Engineering Curricula—*C. O. Reed*
- Agricultural Engineering Administration—*J. B. Davidson*
- Subject Matter in the Agricultural Engineering Curriculum—*H. B. Walker*
- Summer Camps or Courses—*B. D. Moses*
- Service Courses in Agricultural Engineering—(Agricultural) *H. E. Pinches*; (Vocational) *D. G. Carter*
- What Are Agricultural Engineers Doing? — *J. B. Davidson*
- Who Does the Agricultural Engineer's Work?—*Dan Scoates*
- Graduate Work in Agricultural Engineering—*E. G. McKibben*

3 RESEARCH—Discussion led by *H. B. Walker*
- Project Presentation—*R. W. Trullinger*
- Graduate Research—*E. G. McKibben*
- Experiment Stations—*E. V. Collins*

II — STUDENT GROUP

(Gregorian Hall, Women's Building)

10:00 a.m. to 12:00 m.

Presiding: *Lawrence H. Skromme*, president, National Council of ASAE Student Branches

1 Problems in Planning a Curriculum in Agricultural Engineering—(Speaker to be selected)

2 The Agricultural Engineering Curriculum from the Students' View—(Speaker to be selected)

DISCUSSIONS:

(a) From the Standpoint of Required Subjects—(Speaker to be selected)

(b) From the Standpoint of Teaching Methods—(Speaker to be selected)

(c) From the Standpoint of Laboratory Equipment—(Speaker to be selected)

III — COMMITTEE ON EXTENSION

10:30 a.m. to 12:30 p.m.

(Upper Parlor, Women's Building)

Presiding: *K. J. T. Ekblaw*, committee chairman

Roundtable discussions of problems of common interest to extension agricultural engineers in both public service and private industry

2:00 to 4:00 p.m.—Committee and group conferences, etc.

I — COMMITTEE ON EXTENSION

(Upper Parlor, Women's Building)

Presiding: *K. J. T. Ekblaw*, committee chairman

1 The Relationship of Extension Engineers to Workers in other Technical Fields.—*Dr. C. W. Warburton*, director, Agricultural Extension Service, U.S.D.A.

3:00 to 5:00 p.m.—Special social program

5:00 to 9:30 p.m.—Picnic on South Campus for ASAE members and guests.

TUESDAY, JUNE 22

9:00 to 10:30 a.m.—GENERAL SESSION

(Little Theater, Lincoln Hall)

Presiding: *R. U. Blasingame*, President

1 Meeting opened—*E. W. Lehmann*, chairman, Local Committee

2 Address of Welcome—(Speaker to be selected)

3 Thermostats and Thermometers (President's Annual Address)—*Ralph U. Blasingame*, professor of agricultural engineering (head of the department), Pennsylvania State College

4 Responsibilities of the Agricultural Engineer in Economic and Social Development—*Ralph E. Flanders*, president, Jones & Lamson Machine Co.

10:30 a.m. to 12:30 p.m.—TECHNICAL SESSIONS

I — POWER AND MACHINERY DIVISION

(Upper Parlor, Women's Building)

Presiding: *O. E. Eggen*, division chairman

TOPIC: The Farm Tractor Fuel Problem

1 The Fuel Situation from the User's Standpoint—*F. W. Duffee*, University of Wisconsin (20 min)

2 The Tractor Fuel Problem from the Refiner's Viewpoint — *M. D. Gjerde*, Standard Oil Company (Indiana) (20 min)

3 Proposed Standardization of Tractor Fuels — *L. B. Sperry*, International Harvester Co. (20 min)

II — RURAL ELECTRIC DIVISION

(Room 114, Women's Building)

Presiding: *G. A. Rietz*, division chairman

TOPIC: Extending Electric Service in Rural Areas

1 Helping Farmers Prepare for Electric Service—*H. N. Stapleton*, University of Vermont (15 min)

2 Analysis of Factors Involved in Rural Electric Service—*I. L. Craig*, Philadelphia Electric Co. (15 min)

3 Adequate Farm Wiring Installations—*H. W. Riley*, New York State College of Agriculture, Cornell University (15 min)

Discussion: *Geo. W. Kable*, Tennessee Valley Authority (10 min)

4 Electrification of Rural America, Status and Problems—*Dr. E. A. White*, director, Committee on the Relation of Electricity to Agriculture (15 min)

III — FARM STRUCTURES DIVISION

(Room 210, Women's Building)
Presiding: *A. M. Goodman,* division chairman

TOPIC: The Agricultural Engineer's Responsibility in the Promotion of Better Farm Buildings

1 Why Have Better Farm Buildings?—*Wm. Boss,* University of Minnesota (15 min)
2 Farm Structures Research as a Basis for Promotion—*Henry Giese,* Iowa State College (15 min)
3 Industry's Contribution to Better Farm Buildings—*W. G. Kaiser,* Portland Cement Assn. (15 min)
4 Organization for the Promotion of Better Farm Buildings—*K. J. T. Ekblaw,* American Zinc Institute (15 min)

IV — SOIL AND WATER CONSERVATION DIVISION

(Little Theater, Lincoln Hall)
Presiding: *C. E. Ramser,* division chairman

1 Irrigation by Sprinkling—*J. E. Christiansen,* University of California (15 min)
2 The Status of Land Drainage in the United States—*J. G. Sutton,* U. S. Bureau of Agricultural Engineering (15 min)
3 Stream Bank Protection—*I. L. Saveson,* U. S. Soil Conservation Service, and *Virgil Overholt,* Ohio State University (15 min)
4 Committee Reports

2:00 to 5:00 p.m.—Special Plow Exhibit
(Little Theater, Lincoln Hall)

2:00 to 4:00 p.m.—Committee and group conferences, etc.

I — STUDENT GROUP

(Gregorian Hall, Women's Building)

1 The Agricultural Engineering Student and His Relation to ASAE—*Raymond Olney,* secretary, ASAE
2 Reports from Student Branches
3 Business Session

4:00 to 5:00 p.m.—ANNUAL BUSINESS MEETING
(Little Theater, Lincoln Hall)

8:00 p.m.—Theater party for women and children.
Get-together smoker for men

WEDNESDAY, JUNE 23

9:00 to 10:30 a.m.—GENERAL SESSION
(Little Theater, Lincoln Hall)
Presiding: *R. U. Blasingame,* president

1 New Horizons for Agricultural Engineers—*Dr. C. W. Warburton,* director, Agricultural Extension Service, U. S. Department of Agriculture
2 ADDRESS—*C. O. Reed,* 1937 recipient of the Cyrus Hall McCormick Gold Medal (Professor of Agricultural Engineering, Ohio State University)

10:30 a.m. to 12:30 p.m.—TECHNICAL SESSIONS

I — POWER AND MACHINERY DIVISION

(Upper Parlor, Women's Building)
Presiding: *F. W. Duffee,* division vice-chairman

SYMPOSIUM: Quick-On and Quick-Off Power Farming Equipment—Led by *R. H. Wileman,* Purdue University (15 min)

Discussions by representatives of farm equipment manufacturers (10 min each)

II — RURAL ELECTRIC DIVISION

(Room 114, Women's Building)
Presiding: *G. A. Rietz,* division chairman

1 Educational Programs with Farm Groups—*A. V. Krewatch,* University of Maryland, (10 min)
2 Assisting the Farmer to Enjoy the Benefits of Electric Service — *John M. Carmody,* administrator, Rural Electrification Administration
3 A Sound Utilization and Load Building Activity—*H. J. Gallagher,* Consumers Power Co. (10 min)
4 A Seasonal Plan for Rural Electrification Development—*C. L. East,* Penn Central Light & Power Co. (10 min)
5 Light—Possibilities and Opportunities on the Farm—*L. C. Porter,* General Electric Company (10 min)

III — FARM STRUCTURES DIVISION

(Room 210, Women's Building)
Presiding: *R. G. Ferris,* division vice-chairman

1 Design Factors for Small Farm Houses—*H. E. Wichers,* Kansas State College (20 min)
2 Farm House Design from the Standpoint of Architectural Beauty—*Dean Rexford Newcomb,* University of Illinois (20 min)
3 Use of Insulation Under High Humidity Conditions—*A. D. Edgar,* U. S. Bureau of Agricultural Engineering (20 min)

IV — SOIL AND WATER CONSERVATION DIVISION

(Little Theater, Lincoln Building)
Presiding: *C. E. Ramser,* division chairman

1 Management and Use of Agricultural Lands—*Noble Clark,* Wisconsin Agricultural Experiment Station (15 min)
2 Highway Erosion Control Problems—*John E. Snyder,* Tennessee Valley Authority (15 min)
3 Erosion Control Problems of the Railways—*Geo. M. O'Rourke,* Illinois Central System (15 min)
4 Terracing Extension Methods in Alabama—*J. B. Wilson,* Alabama Polytechnic Institute (15 min)

2:00 to 4:00 p.m.—Committee and group conferences, trips, etc.

7:00 to 9:30 p.m.—ASAE Annual Dinner
J. P. Fairbank, toastmaster
Entertainment
Award of FEI Student Branch Cup
Award of Cyrus Hall McCormick Medal

9:30 p.m.—Dance (Gymnasium, Women's Building)

THURSDAY, JUNE 24

9:00 a.m. to 12:00 m.—TECHNICAL SESSIONS

I — POWER AND MACHINERY DIVISION

(Upper Parlor, Women's Building)
Presiding: *O. E. Eggen,* division chairman

TOPIC: Natural and Artificial Curing of Forage Crops

1 Farm Experience in Forage Curing—*Howard T. Greene* Brook Hill Farms (20 min)
2 A Review of Recent Progress in Natural and Artificial Forage Curing—*W. M. Hurst,* U. S. Bureau of Agricultural Engineering (20 min)
3 COMMITTEE REPORTS

II — RURAL ELECTRIC DIVISION

(Room 114, Women's Building)
Presiding: *F. E. Price,* division vice-chairman

1 Electricity Applications in Dairy Farming—*Howard T. Greene,* Brook Hill Farms (15 min)
2 Use of Electricity in Fruit Farm Operation—*W. C. Reed,* Vincennes Nurseries (15 min)

WANTED...

from the Agricultural

PIONEER... *1842 Model. With oxcart and plow, rifle and food supplies, pioneers streamed westward to wrest new wealth, new farm land from the wilderness.*

MODERN FARMING NEEDS THE

New Pioneers *Schools of America*

A challenge to Agricultural Engineers who are graduating with the class of 1937

The job of building a better world is not yet completed.

Twenty-five years ago the average farmer had a hired hand and his boys to help him, plenty of horses, a limited number of tools.

He would scarcely have known the names of such modern implements as two- and four-row cultivators with power lifts, field ensilage harvesters, corn pickers, potato diggers, rotary hoes.

In 1912 there was no row crop tractor. Less than 10,000 tractors had been manufactured. They weighed more than 500 pounds per rated belt horsepower. Only enthusiasts predicted a real farm future for them.

Last month tractors on farms numbered 1,382,872, according to an estimate of *Farm Implement News*. The average weight per maximum *drawbar* horsepower of tractors being sold today is between 200 and 250 pounds.

Will not the next 25 years bring about similar progress?

Look at one item of farm power alone. In 1936 the tremendous total of 17,500,000,000 horsepower hours of power was produced by the farmers of America, according to the estimate of the U. S. Department of Agriculture. At the conservative estimate of 10.7 cents to produce each horsepower hour, the annual bill for farm power reaches the staggering total of $1,872,500,000. Even if it were only half this amount, think of the tremendous saving a reduction of one- or two-tenths of a cent would make—from $8,750,000 to $17,500,000 annually.

Today, in the tractor field alone, the opportunity exists to cut the bill by producing from 20% to 25% more power from the same amount of fuel.

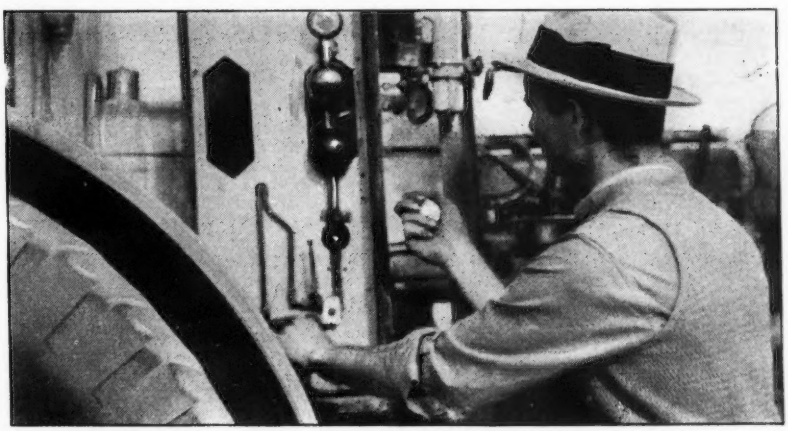
This seeming miracle can be accomplished by the application of a basic engineering principle: increasing the compression of the tractor engine and gaining greater engine efficiency.

A high compression, gasoline-burning tractor delivers greatly increased power at the drawbar and at the belt, as compared with a low compression, distillate-burning tractor of similar make and size. This has been proved in numerous outdoor and indoor laboratory tests and in thousands of practical farm demonstrations.

Thus, with high compression, the farmer gets greatly increased useful power with the same engine, the same tractor, the same dead weight. In many cases, this means that a two-plow tractor can pull three plows. The tractor can be run at higher speeds. Far more work can be done in the same time. More implements can be attached to the tractor. Yield per acre can be increased because plowing, planting, cultivating and harvesting can be done quicker on days best suited to produce a maximum yield.

Five years ago high compression was almost unknown in tractor engines. Today it is the most talked about engine feature. Five years from now, it is predicted, it will be as standard in tractor engines as it is in automobiles today.

Now, at the start of this five-year period, is your opportunity to benefit most from this growing trend to high compression tractor engines. If you are going into tractor design work, *design* for high compression. If you are going to operate a farm, demand the benefits of high compression in the tractors you use. If you are going into the farm equipment business, sell high compression. If you accept the responsibility to give the farmer more for his money, then even the next *five* years may show as much progress in agriculture as the last twenty-five. Ethyl Gasoline Corporation, Chrysler Building, New York, manufacturers of antiknock fluids for regular and premium gasolines.



PIONEER . . . *1937 Model. With fuel burette and stop watch, agricultural research engineers test tractor operation, explore new fields of engineering to give the farmer more for his money, reduce the costs of power farming.*

ADDED POWER OF HIGH COMPRESSION

3 Electricity in the Farm Home—*Mrs. Lucile A. Stevenson,* president, Illinois Home Bureau Federation (15 min)
4 Engineering the Household—*P. B. Potter,* Virginia Polytechnic Institute (15 min)
5 Irrigation as Crop Insurance—*C. C. Bell,* Wisconsin Public Service Corp., Wausau, Wisconsin (15 min)
6 Farm Cold Storages—*B. D. Moses,* University of California (15 min)
Discussion—*F. D. Banning,* Florida Power & Light Co. (10 min)
7 The Drying of Hay and Other Farm Crops—*J. H. Fulmer,* Nazareth, Pennsylvania (15 min)

III — FARM STRUCTURES DIVISION

(Room 210, Women's Building)
Presiding: *K. J. T. Ekblaw,* division past-chairman

1 Results of Recent Research in Spontaneous Combustion—*H. E. Roethe,* U. S. Bureau of Chemistry and Soils (20 min)
Discussion—*F. W. Duffee,* University of Wisconsin (10 min)
2 Utilizing the Structural Value of Insulation in Poultry House Construction—*H. M. Ward,* Masonite Corp. (20 min)
3 A Low-Cost Type of Construction for Farm Homes—(Speaker to be selected) (10 min)
4 New Developments in Roofing Nails—*Jas. B. Maze,* W. H. Maze & Co. (15 min)
5 Progress of the Fence Testing Project—*H. W. Riley,* Cornell University (15 min)

IV — SOIL AND WATER CONSERVATION DIVISION

(Little Theater, Lincoln Building)
Presiding: *T. B. Chambers,* division vice-chairman

1 An Extension Program in Soil and Water Conservation—*W. H. McPheters,* Oklahoma A. and M. College (15 min)
2 Special Problems Encountered in Soil Conservation Work—*W. X. Hull,* U. S. Soil Conservation Service (15 min)
3 Results of Experimental Studies in Soil Conservation—*D. D. Smith,* U. S. Soil Conservation Service (15 min)
4 Terrace Project Planning—*C. L. Hamilton,* U. S. Soil Conservation Service (15 min)
5 Studies of Machinery in Relation to Erosion Control Work—*G. E. Ryerson,* U. S. Soil Conservation Service (15 min)
6 Mechanical Methods of Water Conservation on Pasture Land—*P. C. McGrew,* U. S. Soil Conservation Service (15 min)

NEWS

College Group Election

IN THE election of two members to serve two years each on the Advisory Committee of the College Division of the American Society of Agricultural Engineers, F. W. Duffee, professor of agricultural engineering, University of Wisconsin, and H. E. Murdock, professor of agricultural engineering, Montana State College, were elected to the Committee and will begin their terms following the annual meeting of the Society in June. Other members of the Committee for the ensuing year are F. R. Jones, professor of agricultural engineering, A. & M. College of Texas, and B. B. Robb, professor of agricultural engineering, Cornell University. The chairman of the Committee and of the College Division for the coming year will be E. G. McKibben, associate professor of agricultural engineering, Iowa State College, appointed recently by President-Elect Arnold P. Yerkes.

Livingston Talks on Agricultural Engineering

IN the course of a two-month trip in the Northwest, L. F. Livingston, past president of the American Society of Agricultural Engineers, filled seventeen speaking engagements and addressed a total of more than 2500 people, explaining the relation of agricultural engineering to their various group interests. Lack of time forced him to decline several additional invitations to speak.

Among the groups addressed were the engineering assembly of the University of Washington, the agricultural student club at Oregon State College, the Pacific Coast Section of the American Society of Civil Engineers, the engineering students assembly at the University of Idaho and an agricultural engineering dinner of groups from both Washington State College and the University of Idaho. Other addresses were delivered before forestry and chemurgic groups, chambers of commerce, and business men's luncheons.

Georgia State Section Meets

THE spring meeting of the Georgia State Section of the American Society of Agricultural Engineers was held in Athens in the afternoon and evening of April 17, and the morning of April 18. Twenty-nine engineers attended.

The afternoon session was devoted to topics of local professional interest. "Activities in the USDA at Albany" were explained by E. M. Dieffenbach. F. B. Lanham and J. W. Simons reported on their "Farm Housing Studies." G. I. Johnson led the discussion. "A Machine for Harvesting Crimson Clover Seed" was described by F. W. Peikert, and discussed by J. D. White. L. C. Prickett talked on "Rural Electrification in the Southeast," and was followed with discussion by J. C. Oglesbee. "Vegetated Waterways for Controlling Runoff from Terraces" was the subject of a talk by J. C. Tillman. General discussion concluded the technical program.

Section Chairman R. H. Driftmier called for a brief business session after the presentation of papers. Officers elected for the ensuing year were W. N. Danner, Jr., chairman; G. I. Johnson, vice-chairman; and F. B. Lanham, secretary-treasurer. Adjournment of the afternoon meeting followed an inspection of the experimental house in which the farm housing studies are being conducted.

At 7:00 p.m. the group gathered for a banquet. Immediately following this function a dance was given by the Student Branch of ASAE, honoring the engineers and their ladies. The final meeting was held early Sunday morning in the form of an outdoor breakfast on the university campus.

The meeting was successful from every standpoint. Socially, a fine spirit of fellowship prevailed. Professionally, the topics discussed were timely and of value. Those present manifested a real interest in the problems which today confront the profession of agricultural engineering.

Chemurgic Group Plans Third Dearborn Conference

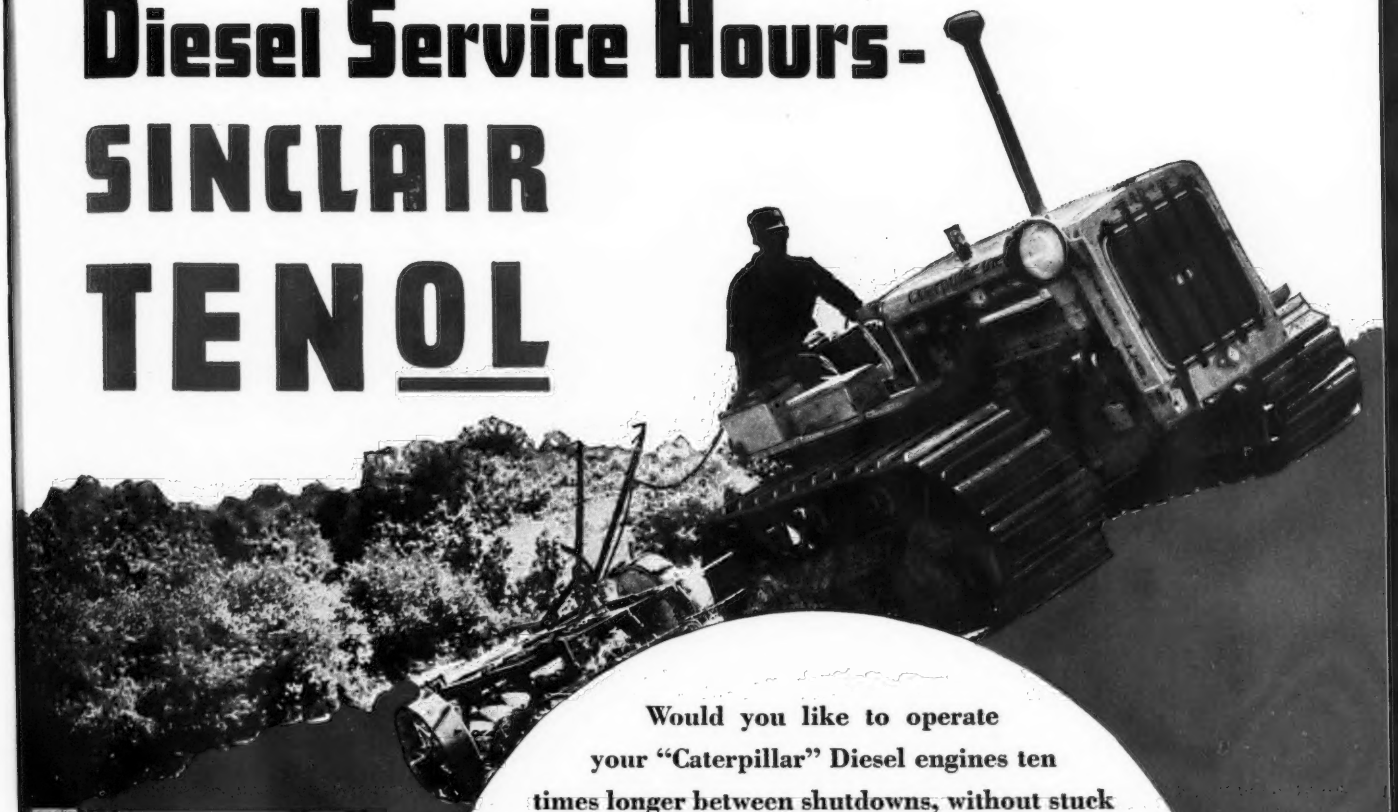
INVITATIONS have been issued for the Third Dearborn Conference of representatives of Agriculture, Industry and Science, May 25, 26 and 27. The Conference, having for its purpose the advancement of industrial uses of American farm crops through applied science, will be held under the sponsorship of the Farm Chemurgic Council and The Chemical Foundation, Inc.

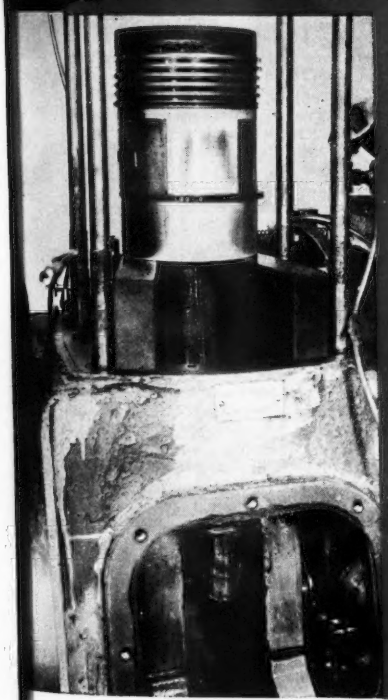
Scheduled sessions of particular interest to agricultural engineers include a "Symposium on New Things"; the conference banquet, at which Wheeler McMillen will serve as toastmaster; and a session on "Motor Fuel from Farm Crops," included in which will be a "Symposium on Raw Materials."

Agricultural engineers desiring to do so will be welcome to attend. It is probable that the ASAE Committees on Industrial Uses for Agricultural Products and on Relations with Farm Chemurgic Council will meet at some time during the conference.

(News continued on page 228)

For TEN times more Diesel Service Hours— SINCLAIR TEN-OL





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Sinclair Ten-ol lubricated this official "Caterpillar" Diesel test engine in a continuous 1093-hour accelerated wear test at the Sinclair Bureau of Standards. The above unretouched photograph shows engine taken down for inspection. Note perfect condition of rings and piston, and the cleanliness of the crankcase after draining. Compare with piston at right.

The finest grade of straight mineral oil was used to lubricate the above piston in a "Caterpillar" Diesel engine during a continuous acceleration test only 1/10 as long as the test described at left. Note in unretouched photo signs of blow-by indicating poor piston seal, carbon-coated piston crown, sludge, plugged oil control rings and gum on piston skirt.

Washington News Letter

from AMERICAN ENGINEERING COUNCIL

AMERICAN Engineering Council is being called upon by members of Congress, engineers and educators in the land grant college groups to support legislation proposing to increase the number of engineering experiment stations and for advice regarding the attitude which should be taken toward such legislation. It has also come to our attention that there is competition between the colleges of agriculture and mechanic arts and state universities for the allocation of funds for the construction and operation of engineering experiment stations.

The Florida Engineering Society passed a resolution at its annual meeting in March and is pressing American Engineering Council to support S.1679 and H.R.3629, bills introduced by members of Congress from Florida. Several engineers who are influential in Florida have also written to us urging action.

American Society of Heating and Ventilating Engineers, which is not a member of American Engineering Council, has asked the American Society of Mechanical Engineers and American Engineering Council to support H.R.3629.

The staff has advised the American Society of Mechanical Engineers to suggest that the American Society of Heating and Ventilating Engineers take competing legislation into consideration. H.R.5531, "to aid engineering and industrial research in connection with colleges and schools of engineering in the several state and territorial universities and colleges and for other purposes" seems to be in competition with S.1670 and H.R.3629, "to provide for establishing engineering experiment stations in the land grant colleges."

Another remotely related group of legislation is found in S.1308 and H.R.4954, "to aid business and economic research in connection with collegiate schools of business in the several state and territorial universities." These bills do not specifically include engineering but they do propose "to promote scientific investigation."

So much confusion has arisen regarding this legislation that President Roosevelt has appointed three committees to study it. The National Research Council was first called upon to appoint a committee headed by Dr. Charles W. White. After the committee had gotten into action, some question arose as to whether it should make a final report, and the President appointed a Committee on Industrial Training headed by Dr. Floyd Reeves of Chicago, who was formerly Director of Personnel with the Tennessee Valley Authority. A third committee has just been started by the National Resources Committee to investigate human resources, which is understood to include questions regarding engineering educational facilities in land grant colleges.

Council's natural position in this matter is to represent the engineering viewpoint and the engineering profession of the country in the public welfare, and the staff is reluctant to go into controversy beyond that point in support of any legislation. We are, therefore, endeavoring to confine our work, in this connection, to the accumulation and dissemination of information concerning the several pieces of legislation, including the opinions of members engineering organizations and our own committees.

Necrology

John Mainland, a former member of the ASAE, passed away April 22. He was a distinguished member of the group of farm machinery designers and development engineers in the Society from 1919 to 1935, and held responsible engineering positions with the J. I. Case Threshing Machine Company, Advance-Rumely Company, and Allis-Chalmers Manufacturing Company. He was a graduate of Wheaton College and of the University of Wisconsin. The latter institution conferred on him the professional degree "Mechanical Engineer" in 1914.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the April issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Willard H. Bixby, assistant engineer-aide, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Box, 192, Havana, Ill.

W. C. Boardman, director, rural development, Kansas Electric Power Co., 700 Massachusetts St., Lawrence, Kans.

Myron G. Cropsey, junior agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture, 1518 Girard St., N. E., Washington, D. C.

C. Kay Davis, project manager, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Bottineau, N. Dak.

F. Rosello Duhagon, general inspector, machinery department, Banco Nacional de Credito Ejidal, Mexico, D. F. (Mail) Calle de Gaudalajara 59-3.

M. P. Espy, camp engineer, Soil Conservation Service, U. S. Department of agriculture. (Mail) c/o H. L. Thomas, RFD No. 4, Waynesboro, Pa.

W. Albert Hogle, superintendent, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) 845 E. Main St., Findlay, Ohio.

R. E. Johnson, manager, rural electric division, Toledo Edison Co., Toledo, Ohio.

D. H. Malcom, sales promotion, agricultural extension bureau, American Rolling Mill Co., Middletown, Ohio.

Oscar W. Meier, utilization division, Rural Electrification Administration. (Mail) 206 Little Falls St., Falls Church, Va.

Ivan G. Morrison, professor of agricultural education, agricultural engineering department, Purdue University, Lafayette, Ind.

G. L. Munroe, rural service engineer, Narragansett Electric Co., 49 Westminster St., Providence, R. I.

Charles W. Naylor, junior agricultural engineer, Soil Conservation Service, U. S Department of Agriculture. (Mail) Clinton, Okla.

Donald W. Niendorf, junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Gays Mills, Wis.

Dwight C. Pettibone, farm electrification representative, Puget Sound Power & Light Co., Seattle, Wash. (Mail) RFD No. 7, Box 363.

Walter H. Pomerene, junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Coshocton, Ohio.

Frank J. Reynolds, manager, agricultural extension department, American Steel & Wire Co., Room 1404, 208 South LaSalle St., Chicago, Ill.

Victor Richardson, soil conservation engineer, Union Central Life Insurance Co., 1600 Dierks Building, Kansas City, Mo.

R. N. White, blockman, J. I. Case Co., 7000 E. 10th St., Indianapolis, Ind.

James C. Wilcox, senior agricultural engineering aide, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Ross Hotel, Amarillo, Texas.

TRANSFER OF GRADES

Vernon S. Peterson, extension agricultural engineer, Pennsylvania State College, State College, Pa. (Mail) 107 Agriculture Hall. (Associate to Member).

ASAE Meetings Calendar

June 21 to 24, 1937—Annual meeting of the Society—University of Illinois, Urbana-Champaign

Iowa Student Branch

SLIDES of the development of the steel plow were shown by Mr. Hobbs of the J. I. Case Co. at our regular monthly meeting of February 23rd. Mr. Hobbs also gave a talk on sales.

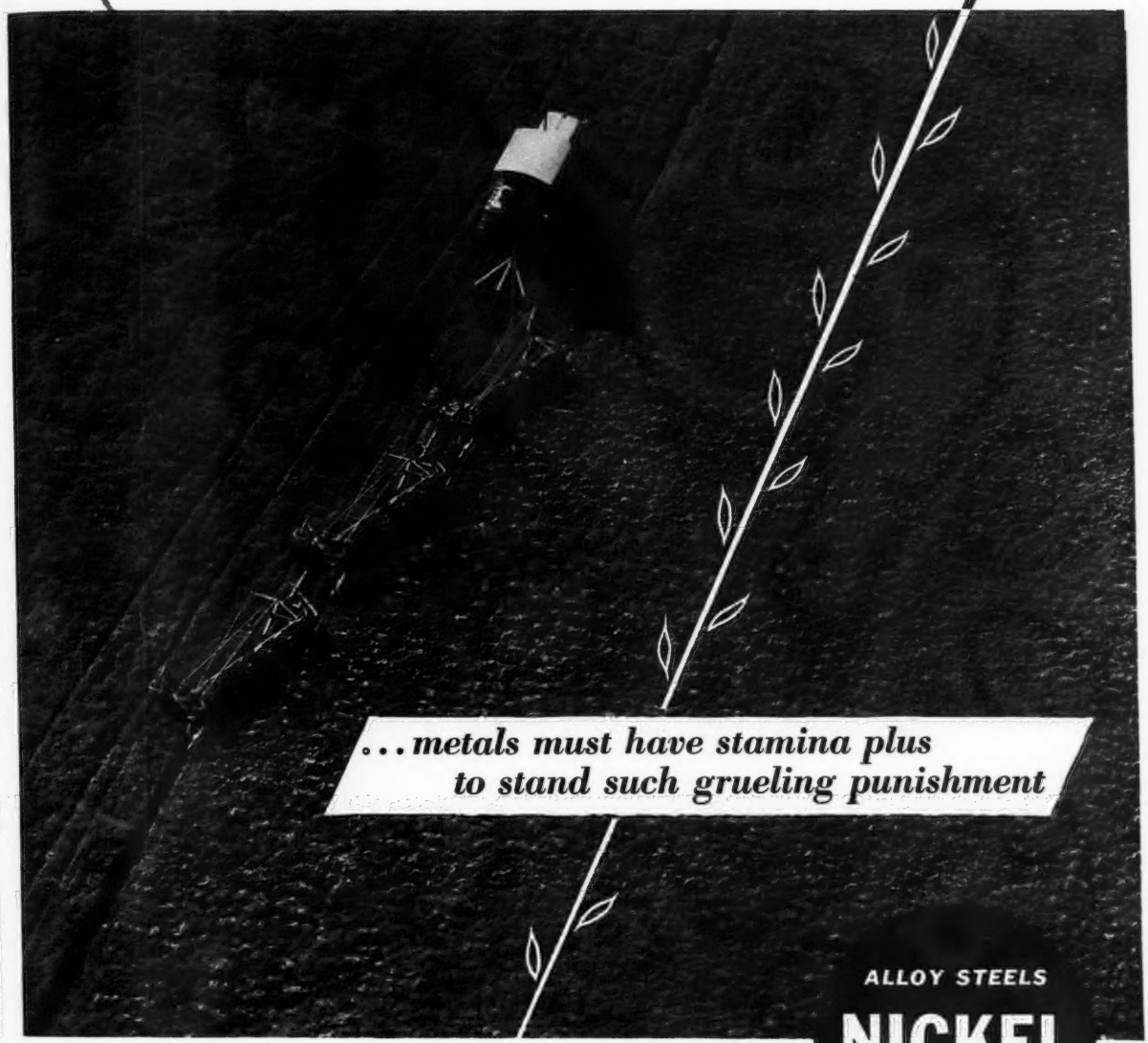
The Memorial Union was the scene of our 22nd Annual Banquet, March 4. Charles E. Friley, president of the College; H. H. Kildee, dean of agriculture; G. T. Baker, president of the Iowa State Board of Education; and L. J. Fletcher, agricultural sales manager of the Caterpillar Co. were among several distinguished guests at our banquet. The theme of the program for the evening was "The Growing of a Crop" and was carried out by addresses on "Observations," by Dr. J. B. Davidson, head of the agricultural engineering department; "Seed Bed Preparation," by Wm. McConnell, senior student; "Seed Time," by C. E. Peach, graduate student; "Cultivation," by Prof. Henry Giese, and "Harvest" by the main speaker of the evening Mr. Fletcher. Our past president of the branch, Orville Fox, officiated as toastmaster for the banquet.

Our next monthly meeting was held April 15, with about 40 members present. David Poor, junior student, presented a paper on "A New Use for an Old Source of Power." Officers for the following year were elected and are as follows: President, Charles Thomas, junior; vice-president Harold Parsley, senior; secretary, Harris Hart, junior; treasurer, Gordon Guymon, junior; Junior Engineering Council representative, Clark Prudhon, sophomore; and Junior Agriculture Council representative, Henry Martin, sophomore.

"Field Dav", which demonstrates to the public the latest developments in agricultural engineering, will be held all day May 14th, during "Veisha," the annual show of Iowa State College. The program for the day is divided into three parts (1) Crop Production (2) Engineering Principles, and (3) Land Development and Soil Conservation.

We expect to send a large delegation to the ASAE annual meeting at Urbana this summer.—Harris Hart, secretary.

15 furrows at a clip



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Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, senior agricultural engineer, Office of Experiment Stations, U. S. Department of Agriculture.

SOIL EROSION IN IOWA, *R. H. Walker* and *P. E. Brown*. Iowa Sta. Spec. Rpt. 2 (1936), pp. 47, figs. 28, map 1. The results of a reconnaissance erosion survey of Iowa is reported, which was conducted in cooperation with the USDA Soil Conservation Service. The observations related to factors influencing soil erosion, the extent and seriousness of erosion in the various parts of the state, and control measures, which have been found to combat soil erosion successfully.

The survey revealed (1) that only about 13 per cent of the total land area of Iowa shows little or no evidence of erosion; (2) that approximately one-third of the land shows slight sheet erosion, and up to 25 per cent of the original surface soil has been washed away; (3) that more than 14 per cent of the land has lost from 25 to 50 per cent of its surface soil by erosion, and that most of this area shows occasional to moderate gullying; (4) that about 31 per cent of the land has been seriously eroded and from 50 to 75 per cent of the original fertile surface soil has been washed away, and that this land has also been moderately to excessively gullied; and (5) that about 9 per cent of the land has been severely eroded and has had 75 per cent or more of the original surface soil washed away by erosion, and that there has also been moderate to excessive gullying in this area.

Approximately 30 billion tons of soil have been estimated to have been washed away from Iowa land since its cultivation was begun by man. This is equivalent to a loss of more than 137,000 tons of soil per 160-acre farm, or approximately 35 per cent of the original surface soil.

Along with the loss of surface soil there has been a tremendous loss of plant nutrients amounting to about 247 tons of nitrogen, 82 tons of phosphorus, and 2,046 tons of potassium for every 160 acres. On the basis of the present price of commercial fertilizers containing these plant nutrients, this loss would amount to approximately $2.97 per acre of farm land. The capital value of Iowa farms is thus being depleted by erosion, a depletion that is actually far greater in value than the land's market price.

Erosion is in the incipient stage on much Iowa land and the evidences of it are not readily recognized.

CARE AND MAINTENANCE OF COTTON-GIN SAWS AND RIBS, *C. A. Bennett* and *F. L. Gerdes*. U. S. Dept. Agr. Circ. 393 (1936), pp. 20, figs. 12. Comparison of the results of ginning tests with gin saws in good and in poor condition showed an average difference in the monetary value of the lint of more than $2 per bale with cotton 1⅛ in and longer and of about $1 per bale with cotton shorter than 1⅛-in staple length.

The greatest factor in raising the value of the bale was the greater lint turn-out with the good saws. The saws in good condition ginned the seed closer than the worn saws, resulting in an average difference for all cottons and conditions employed in this study of about 10 lb of lint per 1,500 lb of seed cotton. The second factor was the enhancement in grade. Increase in staple length was of only minor importance.

Using saws in poor condition as compared to the saws in good condition increased the time of ginning about 30 per cent with the longer and about 20 per cent with the shorter staple cottons. Although the power requirement was slightly less with worn saws, the energy consumption was equal or greater because of the added ginning time.

Sharpening procedure with some machines comprises only a 2-stage gumming and side dressing; while with others it is a 3-stage gumming, side-dressing, and filing or sand-box operation. For hand-picked short-staple cottons and for all roughly harvested cottons the 2-stage method is usually sufficient, but the 3-stage method is to be recommended for hand-picked long-staple cottons.

Gin saws handling roughly harvested cotton require more frequent sharpening than those handling clean-picked cotton, and increase in percentage of damp or wet cotton for either method of harvesting increases the damage to the saw teeth and the frequency with which they must be reconditioned.

The best method of keeping gin saws in proper condition and protecting them from rust during the idle season is to cover them with a coat of suitable oil, which can be easily removed at the beginning of the next ginning season.

Gin ribs require periodic attention in order to preserve the essential relations with the saws that contribute to smooth and satisfactory ginning. The saws should revolve in a central position between each pair of ribs, or with a space equal to a saw thickness on each side, to prevent dragging of the teeth against the ribs and the consequent adverse effects on both cotton and saws.

Worn ribs may be replaced by new ones or repaired by various methods. These repairs consist of welding new materials upon the worn spots to build up the ribs, followed by grinding to correct dimension and shape; or covering the worn surfaces with hardened plates of suitable width and minimum thickness to once more give well-defined edges to the ribs. A smooth polish on the ribs contributes to good ginning and can be preserved from season to season by coating with oil.

CROPPING SYSTEMS IN RELATION TO EROSION CONTROL, *M. E. Miller*. Missouri Sta. Bul. 366 (1936), pp. 36, figs. 18. This report has been prepared in cooperation with the Soil Conservation Service. It is based on a state-wide survey of erosion conditions in Missouri, which revealed the fact that soil losses in the state resulting from erosion are much more serious than have generally been recognized.

According to this survey, one-half of the total area of the State has lost at least one-half of the surface soil, and this has taken place in about three generations.

It was found that erosion from cultivated, uncropped land totals approximately twice that from land in continuous corn. However, erosion from continuous wheat is only about half, and that from a good rotation is less than 20 per cent of that from continuous corn. The erosion from continuous sod is almost negligible. In general these results are taken to indicate that under ordinary conditions cropping and cultural systems may be so adjusted as largely to control erosion losses.

It is concluded that the standard rotations consisting of 1 or 2 yr of corn, 1 or 2 yr of small grain, and 1 or 2 yr of clover or clover and grass, represent some of the most effective cropping systems known for controlling erosion. The various combinations of small grain crops and Korean lespedeza offer a great deal in the control of soil erosion under Missouri conditions.

When soybeans are sown in rows on rolling land this crop may cause so much erosion as to result in very serious soil losses. In such case the crop should be sown with a grain drill and if possible on the contour. The use of winter cover crops such as barley, rye, or wheat, lespedeza, vetch, and various clovers, is recommended wherever possible in order to lessen erosion losses during the fall, winter, and spring months.

The planting of row and drilled crops on the contour instead of merely with the fence lines offers a great deal for controlling erosion in the case of all soils of rolling topography.

A system of cropping known as strip cropping, which has recently been introduced into Missouri, provides that the crops in a rotation be planted in rather narrow strips, from 50 to 100 ft wide, across the slope. This is very effective in controlling erosion.

OBSERVATIONS ON THE USE OF THE HIGH SPEED WIND-DRIVEN PROPELLER FOR GENERATING LOW VOLTAGE ELECTRICITY, *W. H. Sheldon*. Michigan Sta. Quart. Bul., 19 (1936), No. 1, pp. 6-12, figs. 2. It was found that the successful operation of any wind-driven battery charger depends largely upon a good exposure to the wind and the ability of the propeller to absorb energy from winds of from 8 to 12 mph velocity.

Propellers with a very high tip speed ratio revolved with less speed than those with a 9:1 ratio, thereby defeating the purpose of the higher tip speed ratio. A propeller with four blades generated about 50 per cent more current than a 2-blade propeller using the same wind stream.

The length of a propeller for direct dirve, used with the lower speed generator was found to be limited to 5 ft in 8 to 10 mph winds. Rewinding the generator to start charging at 200 rpm would make possible the use of a 7-ft propeller for direct drive use. The 7-ft propeller should absorb twice as much energy from the wind as a 5-ft propeller. *(Continued on page 234)*

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UNITED STATES STEEL

Agricultural Engineering Digest

(Continued from page 230)

1935 TRACTOR COSTS IN MICHIGAN, *K. T. Wright.* Michigan Sta. Quart. Bul., 19 (1936), No. 1, pp. 21-23. Data are given on the costs of operating tractors in Michigan in 1935, including all cash expenses of operation such as fuel, lubricants, repairs, labor for care, fixed costs of depreciation, interest on tractor value, and charge for shelter. The records relate to 41 tractors.

POULTRY HOUSES FOR MANITOBA, *M. C. Herner.* Manitoba Dept. Agr. and Immigr. Ext. Bul. 103 (1936), pp. 31, figs. 24. Information is presented on the plans and construction of poultry houses adapted to conditions in Manitoba, together with working drawings and building material for specific structures.

WATER RESOURCES OF THE EDWARDS LIMESTONE IN THE SAN ANTONIO AREA, TEXAS, *P. Livingston, A. N. Sayre,* and *W. N. White.* U. S. Geol. Survey, Water-Supply Paper 773-B (1936), pp. 58-113, pl. 1, figs. 4. This report, prepared in cooperation with the Texas State Board of Water Engineers, deals with the ground water resources of the general area in which San Antonio, Tex., is situated.

SOIL EROSION AND ITS CONTROL IN THE UNITED STATES, *W. C. Lowdermilk,* U. S. Dept. Agr. Soil Conserv. Serv., 1936, pp. 12, fig. 1. The purpose of this paper, according to the author, is to comment in a broad way on the program of man-induced erosion and its control in the United States. The first part of the paper reviews the condition of the American continent in early colonial days, and the second part describes the present condition of the land after three centuries of exploitation. The third part discusses methods of control which are being undertaken.

AUTOMOBILE EQUIPMENT FOR FIELD WORK, *A. T. Strahorn.* U. S. Dept. Agr., Soil Conserv. Serv., 1936, pp. [1] + 3, pl. 1. A brief discussion is presented of the manner in which automobiles are equipped for use in extended survey trips.

HOMEMADE ELECTRIC HAY HOISTS, *H. D. Garver.* Wash. State Col. Ext. Bul. 206 (1935), pp. 4, figs. 2. This equipment is briefly described and illustrated.

HOMEMADE POTATO SORTING TABLE, *H. L. Garver.* Wash. State Col. Ext. Bul. 222 (1936), pp. 4, figs. 2. This device is briefly described and diagrammatically illustrated and a bill of materials presented.

HEATING SYSTEMS FOR APPLE-WASHING MACHINES, *R. H. Reed.* Illinois Sta. Circ. 457 (1936), pp. 37, figs. 11. Technical information is presented on heating systems for apple washing machines, together with data on installation and operation. An appendix presents methods used in analyzing heat losses and transfers.

SILTING OF RESERVOIRS, *H. M. Eakin.* U. S. Dept. Agr., Tech. Bul. 524 (1936), pp. 142, pls. 16, figs. 29. The purpose of this report is to present a preliminary outline of the more important aspects of reservoir silting, and to summarize the results of studies made previously by other agencies, together with the findings of the Soil Conservation Service during the fiscal year ended June 30, 1935.

The data show that silting of reservoirs is a practical problem of first order of importance in the southeastern, southern Great Plains, and southwestern type areas of the United States, wherever accelerated erosion is in force. Observations made on the many other reservoirs visited but not yet surveyed, and on erosional conditions along all routes of travel, emphasize the dependence of undue rates of silting upon man-induced erosion and the general prevalence of these conditions over broad areas of the country.

In the Southeast, reservoir silting results chiefly from erosion of deep residual soils as influenced by human occupation. Lower rates obtain in mountainous and other sections wherever the natural forest cover is practically intact. Higher rates go with agricultural practices in the lower Piedmont country—practices that can be greatly improved upon from the standpoint of erosion. Organized cooperation of the agricultural population toward better terrace, and crop practices and rededication of oversteep lands to noncultivated crops or forest, is eminently in order. Also much benefit can come from structural and vegetational gully control.

In the southern Great Plains, higher rates of silting relate to erosion of sedimentary soils under agricultural and grazing practices. Greater attention to terrace and contour cultivation, cover and strip cropping, and control of incipient gullies, can contribute material improvement. More restricted grazing and range restoration is needed in many places. Silt detention above reservoir level in broad tributary valleys in most reservoir watersheds also can be effectively and profitably employed.

In the Southwest, higher rates of silting are largely the result of over-grazing and its consequence of extraordinary sheet and gully erosion. Sheet erosion perhaps can benefit in time through further restriction of grazing beyond that already imposed by the sparseness of remaining grasses. Arroyo and gully production of sediment can be reduced or even prevented from increasing, only by direct engineering methods. Silt detention above reservoir level in broad tributary valleys by earth barriers and by growth of vegetative screens in delta areas is highly practicable in many cases.

In would also appear, in view of the indications of underflow and congregation against the dams in this region of muddy flood waters, that important reduction of rate of silting is probably feasible through selective wastage of heaviest charge waters through low-placed outlet gates.

In broad national view it appears that exorbitant rates of depletion of reservoir storage by silting are widely prevalent, and that the problem of protection of reservoirs from this menace goes hand in hand with that of saving farm and range lands from impairment and destruction by uncontrolled erosion.

An appendix presents instructions for reservoir sedimentation surveys.

SUBSIDENCE OF PEAT SOILS IN FLORIDA, *B. S. Clayton,* U. S. Dept. Agr., Bur. Agr. Engin., 1936, pp. 15, figs. 5. The results of studies of subsidence of peat soils following drainage, conducted by the Bureau of Agricultural Engineering in cooperation with the Florida Experiment Station over a period of 20 yr, are summarized.

In the Everglades area the available data show the greatest depths of peat soil to be near Lake Okeechobee and a gradual decrease in this depth as the edge of the Everglades is approached. Some records along the east side of the lake show depths of from 12 to 14 ft. Most of the muck and peat soil now in cultivation around Lake Okeechobee is in pumping units in which the major subsidence has already taken place.

In the heavier muck soils, such as the "custard apple" belt adjacent to Lake Okeechobee, the subsidence appears to be less than that in the saw grass peat farther from the lake. This is due to the higher mineral content and greater density of the custard apple soil. Subsidence appears to be proportional to the depth of deposit above the permanent water table, or to the total depth where the water table is below the bottom of the deposit, as in the Davie area.

Following drainage, the rate of subsidence decreases with time. The curve of subsidence apparently approaches a tangent parallel to the time axis, and it seems probable that if fires are prevented, the rate of subsidence will be reduced to a very small amount. The small loss due to slow oxidation may be largely offset by the addition of the fibrous portion of plant roots. As subsidence continues, the density of soil above the water table apparently increases. The available data appear to show that cultivation does not account for any considerable portion of the total subsidence.

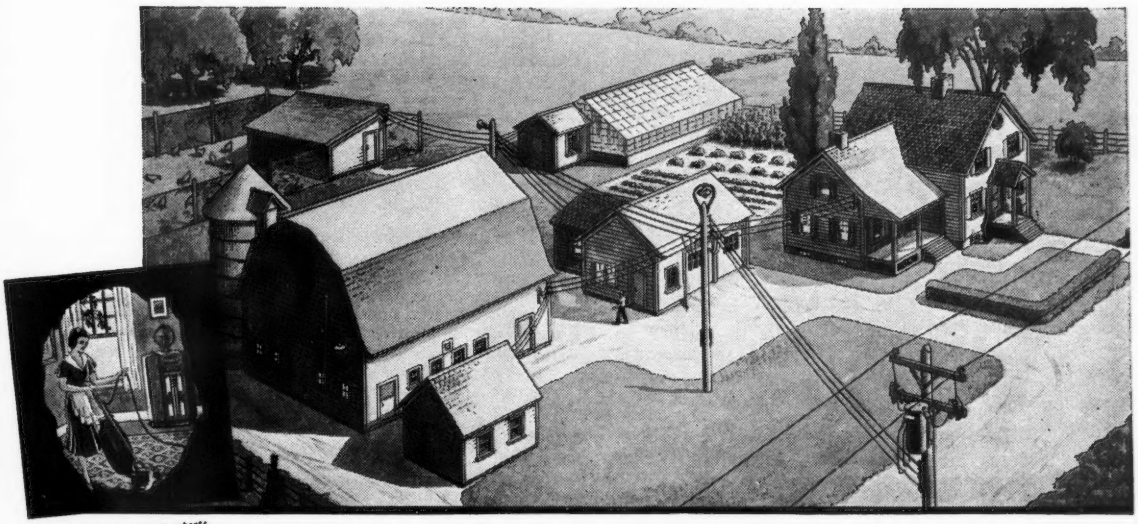
The available data for deep peat deposits indicate total losses in elevation of 4 to 5 ft in the first 20 yr following original drainage, and it seems probable that an additional loss of as much as 1 ft may occur in the next 10 yr. However, if adequate drainage had been maintained in the deep peat areas by deepening the drainage systems, the rate and amount of subsidence would probably have been greatly increased over actual figures obtained. If the depth of soil underlain with rock becomes less than 2.5 to 3 ft successful cultivation will be difficult on account of the limitation in depth of farm ditches.

PACIFIC DRAINAGE, BRITISH COLUMBIA AND YUKON TERRITORY, CLIMATIC YEAR 1929-30, *C. E. Webb.* Canada Dept. Int. Water Power and Hydrom. Bur., Water Resources Paper No. 67 (1935), pp. 316, pl. 1. This report presents the results of hydrometric investigations in the Province of British Columbia for the climatic year ended September 30, 1930.

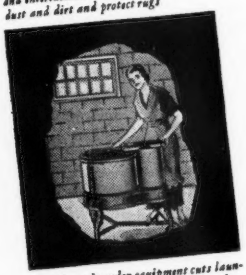
GEOLOGY AND GROUND-WATER RESOURCES OF THE ELIZABETH CITY AREA, NORTH CAROLINA, *S. W. Lohman.* U. S. Geol. Survey, Water-Supply Paper 773-A (1936), pp. [2] + 57, pls. 4, figs. 5. This report, prepared in cooperation with the North Carolina Department of Conservation and Development, describes the geology and ground water resources of parts of Camden and Pasquotank Counties of North Carolina that lie within a radius of about 10 miles of Elizabeth City. *(Continued on page 236)*

Give Electricity a Chance

Install G-E Farm Wiring



G-E radio sets bring news, crop reports, and entertainment. G-E cleaners remove dust and dirt and protect rugs



G-E home laundry equipment cuts laundrying time in half, cleans clothes thoroughly, and preserves their life

G-E portable farm motors operate ensilage cutters, feed grinders, wood saws, huskers, shredders, etc.

SEVENTY out of every hundred farm families who have installed electricity have, within two years after the installation, been unable to enjoy many much-desired additional uses of electricity because they had skimped on their wiring.

Avoid "skimped wiring" as you would a tubercular cow. It strangles your use of electric services, jumps up your costs, and demands expensive additions and alterations every few years.

A "roomy" wiring system with large enough wire, good materials, and plenty of outlets, is the very foundation that supports the full, profitable, enjoyable use of electricity.

For your own protection and economy, have a competent contractor install this kind of a wiring system. Demand "G-E Farm Wiring." It will last a lifetime and give you the best and lowest-cost operation of every electric device for use on the farm. You install it and forget it. You don't even have to worry about fuses — little circuit breakers like those used in factories take the place of fuses. A flip of a handle resets them if they trip out on overloads.

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The G-E Kitchen saves many steps, simplifies food preparation and cooking. Shown here are G-E refrigerator and G-E range

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GENERAL ELECTRIC

Agricultural Engineering Digest

(Continued from page 234)

POTATO WASHING INVESTIGATIONS, *C. L. Vincent* and *H. L. Garver*. Washington Sta. Bul. 332 (1936), pp. 24, figs. 7. Different commercial potato washers are described, an experimental washer is described and illustrated, and the results of experiments with it briefly presented.

The results indicate that washed potatoes stood up in storage as well as unwashed potatoes, and that decay was greater at higher temperatures than at lower temperatures. Dry rot was particularly prevalent in potatoes in common storage.

The types of commercial washers investigated involved the spray, flood, splash, and abrasive principles of washing. The spray type of washer was the simplest of all the washers tested and consisted mainly of two pipes, each containing three rows of small holes, one placed above and the other below a conveyor belt.

The flood or splash type of washer works on the principle of recirculating the water in a tank and pumping it from the tank to a flood rack above a conveyor. Fresh water is added constantly to replace that carried off on the potatoes. In addition there may be some abrasive action, depending upon whether or not brushes are used in the cleaning process.

The abrasive washer consisted of a small hopper, a rigid bar type of conveyor, and a rotating cylinder. The cylinder is lined with cocoanut-husk doormats and rotated at a peripheral speed of approximately 135 ft per minute (inside diameter).

The capacities of these machines varied from 1 to 5 tons per hour, and the power requirements were from 1.5 to 5 hp. The quantity of water required varied according to the machine, but was approximately 1,000 gal of water per ton of potatoes.

The experimental washer was built on a soak-rinse principle. It consisted in general of a soak tank, a conveyor made of a flexible metal chain link conveyor 18 in wide with a 1.25-in mesh, and a rinse.

The capacity of this washer is approximately 1.5 tons of potatoes per hours, or it is about one-half as large as those found in commercial operation. If run at a speed to require approximately 1.25 min for the potatoes to pass through the water, washing is satisfactory.

INSTALLING FORCED DRAFT IN PRUNE DRIERS, *F. E. Price*. Oreg. State Hort. Soc. Ann. Rpt., 27 (1935), pp. 90-92. The results of experience at the Oregon Experiment Station on the installation of fans in natural draft driers is briefly presented.

PRACTICAL ELECTRICITY AND HOUSE WIRING, *H. P. Richter*. Chicago: Frederick J. Drake & Co., 1934, pp. 183, figs. 208. This is a practical book of instruction covering in detail all branches of electrical work as applied to wiring of small buildings. It contains chapters on electricity and how it is measured; dictionary of common devices; principles of circuits; wires and insulation; splicing and soldering; underwriters' electrical codes; two and three-wire systems; polarizing and grounding; fuses and circuits; wiring methods; service wires and switches; plan your installation; wiring new houses—knob-and-tube; wiring with conduit; wiring with armored cable; wiring with nonmetallic cable; installing switches, fixtures, etc.; miscellaneous useful additions; wiring houses after they are built; alterations and additions; wire sizes; wiring farm buildings; motor characteristics—motor wiring; principles of efficient lighting; AC and DC—single-phase and three-phase; appliances—home repairs; and isolated plants.

PURDUE EXPERIMENT STATION REPORTS ON EFFECT OF "FREON" ON FRUIT IN STORAGE, *C. E. Baker*. Heating, Piping, and Air Conditioning, 8 (1936), No. 3, pp. 94, 96, 98. Studies conducted at the Indiana Experiment Station are briefly reported which showed that Freon appears to be a safe refrigerant for use in the storage of apples from the toxicity standpoint. Its presence in the atmosphere appears to be harmless, except possibly in the case of extreme concentrations.

EXPERIMENTAL STUDY OF THE SCOUR OF A SANDY RIVER BED BY CLEAR AND BY MUDDY WATER, *C. A. Wright*. Jour. Res. Natl. Bur. Standards [U. S.], 17 (1936), No. 2, pp. 193-206, figs. 14. This paper reports the results of an experimental comparison of the scour produced in a bed of fine sand in a sloping flume by muddy water and by clear water.

Critical velocities of the water were determined for incipient movement of the sand bed in the form of riffles and were found to be greater for muddy water, that is, water containing an appreciable amount of clay in suspension, than for clear water. With the muddy water an increase of about 10 per cent in mean velocity was necessary to scour out the same amount of Colorado sand as was scoured by clear water under otherwise similar conditions. For coarser sands this increase was greater.

It was concluded that when clear water is discharged at the Boulder Dam it will cause greater scouring away of the sand bed than did the muddy water under previous conditions.

INVESTIGATIONS ON MACHINERY USED IN SPRAYING.—II, NOZZLES, *C. Davies* and *G. R. B. Smyth-Homewood*. Jour. Southeast, Agr. Col., Wye, Kent, No. 36 (1935), pp. 62-85, pls. 11, figs. 7. This is the second report of experiments on the subject conducted at the Southeastern Agricultural College in which a method to determine the surface area of trees covered by spray fluid is described.

Results obtained in the field under commercial conditions showed average cover of about 78 per cent. An analysis of the uniformity and degree of atomization of spray deposit on the trees showed the spray cover efficiency to average 62 per cent. Further experiments were conducted in the field under various pump and nozzle conditions, and the cover ranged from 60 to nearly 92 per cent. A number of nozzles were tested in the laboratory, and the methods used and some of the apparatus developed are briefly described.

Books Received

FARM MACHINERY AND EQUIPMENT, *by H. P. Smith*. Second Edition. Cloth bound, 6x9 in, XIII + 460 pages, 700 illustrations, indexed. McGraw-Hill, $3.25. A text for farm machinery courses for agricultural and agricultural engineering students, and a reference for others interested in the introduction and use of labor saving equipment for the farm. This edition brings up to date the author's earlier work on the subject, published in 1929. It is divided into fourteen parts covering "Importance of Farm Machinery to Agriculture, Principles of Farm Machinery, Soil Preparation Machinery, Seed-Bed Preparation Machinery, Seeding Machinery, Cultivating Machinery, Dusting and Spraying Machinery, Harvesting Machinery, Seed Preparation Machinery, Feed Preparation Machinery, Fertilizing Machinery, Transportation Equipment, Cleaning and Grading Machinery and Soil-and-Water Conservation Machinery".

WEATHER ELEMENTS, *by Thomas A. Blair*. Cloth bound, 6x9 in, XV + 401 pages, 107 illustrations, indexed. Prentice-Hall, $5.00. A text in elementary meteorology with chapters on The Atmosphere; Observing Temperature, Pressure, and Wind; Observing Moisture, Sunshine, Visibility, and Upper Air Conditions; Solar Radiation and Its Effects; Condensation of Water in the Atmosphere; Interrelations of Temperature, Pressure, and Wind; The General Circulation; The Secondary Circulation; Lesser Disturbances; Weather Forecasting; World Weather; Climate; Climate and Man; Electrical and Optical Phenomena; and The United States Weather Bureau. Appendixes include a bibliography, conversion factors and tables, tables of mean monthly and annual temperatures, and precipitation and climatological section centers of the United States Weather Bureau.

ELECTRIC POWER DEVELOPMENT IN THE U.S.S.R., edited by *Benjamin I. Weitz*, translated into English by Leonard E. Mins, cloth bound, 6x9 in, XVI + 496 pages, 105 illustrations. International publishers, New York, $3.00. A contribution to the Third World Power Conference, presenting the principal technical and economic problems of electrification in the U.S.S.R., by leaders in the activity. It is divided into two parts dealing separately with "Principal Problems of Electric Power Development in the U.S.S.R." and "Prospects of Development of Electric Power Systems." Chapters within these parts cover "Construction of the Electric Power System of the U.S.S.R. in the Light of Modern Electrification," "Electrification and the Reconstruction of the Fuel Supply of the U.S.S.R.," "Steam-Electric Stations and Electric Networks," "Heat and Power Stations and Heating Networks," "Hydroelectric Stations," "The Dnieper Hydroelectric Station in the National Economic System of the U.S.S.R.," "Fundamental Problems of the Development of Electric Power Systems," "The Structure and Location of Generating Plant in Complex Electric Power Systems," "High-Voltage Networks in Complex Power Systems," and "The Principal Coordinated Hydroelectric Developments in the U.S.S.R."

HOW TO MAKE HAY IN THE RAIN is the title of a booklet published by the Molasses Silage Educational Committee. It pictures the advantages and describes methods and equipment for ensiling forage crops with the addition of molasses. It may be obtained free from silo manufacturers, or from the Committee, at Rochester, N. Y., for 10 cents per copy.